

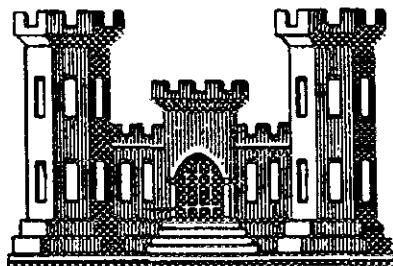
CONNECTICUT RIVER FLOOD CONTROL

**CHICOPEE FALLS
LOCAL PROTECTION PROJECT**

CHICOPEE RIVER, MASSACHUSETTS

DESIGN MEMORANDUM NO. 6

PUMPING STATIONS



U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS WALTHAM, MASS.

APRIL 1963

105

ENOCW-MZ (10 Apr 63)

3rd Ind

SUBJECT: Chicopee Falls Local Protection Project, Chicopee River,
Massachusetts - Design Memorandum No. 6 - Pumping Stations

Office, Chief of Engineers, Washington D. C. 20315, 2 Aug 1963

TO: Division Engineer, U. S. Army Engineer Division, New England

The actions taken in regard to the CCE comments contained in the
preceding CCE 1st intercession dated 10 May 1963 are satisfactory.

FOR THE CHIEF OF ENGINEERS:

2 Incls

1. Plate No. 7 (marked
in green)
2. Cy of Spec - Reference Books

MORRIS A. JOHNSON

Acting Chief, Engineering Division
Civil Works

M. Coffin

Messrs. Coffin/Fowler/Haines/Whittemore/le/515

MEMO (10 Apr 63)

2nd Ind

SUBJECT: Chicopee Falls Local Protection Project, Chicopee River,
Massachusetts - Design Memorandum No. 6 - Pumping Stations

U.S. Army Engineer Division, New England, Waltham, Mass. 25 July 1963

TO: Chief of Engineers, AFCE, Washington, D. C.

Submitted below are comments, referenced to paragraph numbers of
last Memorandum.

Par. 2a. Add to Paragraph 7. - "This pumping station is located at the toe of slope on the land side of an earth dike. Seepage beneath the pumping station is controlled by features of the adjoining dike section and by the minimum depth of adjoining fill which equals approximately the hydraulic head, exposing the tail water at the top of the fill. The adjoining dike section provides for a foundation cut-off and also for relief of foundation seepage pressure by the large gravel fill section along the north and south walls of the pumping station".

Par. 2b. Rock anchors at the Main Street pumping station have been deleted.

Par. 2c. The bar stakes have been checked and corrected to agree with the requirements set forth in paragraph 8c of AF 1110-2-3104. Spacing of bars will be 1-3/4 inches.

Par. 2d. Contract specifications require hydraulic starters.

Par. 2e(1). Contract specifications permit either mixed flow or propeller type pumps and the specified heads are as requested.

Par. 2e(2). The gravity conduit discharge gates can readily serve as bypasses during marginal inflow. Moreover, the pump engines will be equipped with governors permitting adjustable speed settings, to accommodate variable flow conditions. As agreed in recent telephone discussion between Messrs. W. Parker and E. Gredan, additional by-pass provisions are not required.

Par. 2e(3). Pump intake arms have been approximately doubled.

Par. 2f. Electric motor sluice gate operators were provided on all pumping stations previously constructed by the Corps in Chicopee. City desires similar arrangement at these stations to conserve manpower during flood emergencies. Savings resulting from use of manual operators and portable bidet are not considered sufficient to justify change.

MEMO (10 Apr 63)

2nd Ind

25 July 1963

SUBJECT: Chicopee Falls Local Protection Project, Chicopee River,
Massachusetts - Design Memorandum No. 6 - Pumping Stations

Par. 20. Fuel tanks have been changed to above ground installation.

Par. 21. Dehumidifiers have been added in each station.

Par. 22. The pumping station entrance doors will be approved industrial steel paneled doors as called for in the contract plans and specifications.

Par. 21(1). The suggested reduction of 14 feet on the riverside base cannot be made as this would shorten the creep ratio of the adjacent toe walls. The large extension of the riverside matches the heel extension on both adjacent toe walls. Inasmuch as the riverside distance cannot be shortened there is no apparent need for extending the base on the landside cut under the 30-inch RCP pipe.

Par. 21(2). The use of steel channels for step log slots is undesirable. The slots formed into the concrete are easy to form, will require no maintenance, and have little likelihood of being used. The suggested channels will require maintenance that may be difficult due to possible water conditions at the lower part and will protrude out into the pump discharge which is not considered desirable.

Par. 26. Investigation has been made for additional steel required to resist the application of passive pressure to the landside wall.

FOR THE DIVISION ENGINEER,

2 Incls

cc:

cc: Mr. Leslie
Mr. Graden
Mr. Coffin
Mr. Fowler
Mr. Haines
Mr. Whittemore
Eng. Div. File

JOHN W. LEWIS
Chief, Engineering Division

ENGCW-EZ (10 Apr 63)

1st Ind

SUBJECT: Chicopee Falls Local Protection Project, Chicopee River,
Massachusetts - Design Memorandum No. 6 - Pumping Stations

Office, Chief of Engineers, Washington 25, D. C., 10 May 1963

TO: Division Engineer, U. S. Army Engineer Division, New England

1. Reference is made to NED letter dated 19 April 1963, same subject.
2. Design Memorandum No. 6 is approved subject to changes included in NED letter referenced in paragraph 1 above, and to the following comments:
 - a. Paragraph 7 should be expanded to discuss the means of controlling underscrape.
 - b. Paragraph 18, last sentence. Consideration should be given to deleting rock anchors at the Main Street station since the passive pressure of the deep earth embedment is adequate to develop resistance to the unbalanced horizontal forces.
 - c. Paragraph 19. Bar racks should be designed in accordance with the criteria set forth in subparagraph 8b of EM 1110-2-3104.
 - d. Paragraph 21. The engines should be provided with hydraulic starters as described in paragraph 12b(2) of EM 1110-2-3105.
 - e. Paragraph 24.
 - (1) The contract specifications should permit the furnishing of axial flow pumps with either the mixed flow or propeller type of impeller. In specifying the performance for the pumps to be installed in the Main Street Station, the specification should state: "Rating. Each pump shall be capable of operating and delivering not less than 9900 gpm at a pool to pool head of 7.7 feet and not less than 9000 gpm at a pool to pool head of 19.4 feet.". In this case, as the pumps discharge directly into the river, pool to pool head is the difference in elevation between the water surface at minimum stage and the water surface of the river at low water stage or at design flood. It is not considered that the pumps will be required to operate at river stages above design flood. For the Oak Street Station, the specification should state: "Rating. Starting with a static head of 11.1 feet each pump shall be capable of operating and delivering not less than 8600 gpm at a pool to pool head of ____ feet and starting with a static head of 21.0 feet each pump shall be capable of operating and delivering not less than 7000 gpm at a pool to pool head of ____ feet.". Static head is the difference in elevation between the water surface at minimum stage and the river water surface at low water or at design flood when there is no flow through the

ENGCW-EZ (10 Apr 63)

1st Ind

10 May 1963

SUBJECT: Chicopee Falls Local Protection Project, Chicopee River,
Massachusetts - Design Memorandum No. 6 - Pumping Stations

outfall. Pool to pool head is the sum of the static head and the losses for a given flow between the discharge chamber and the river when there is flow through the outfall. A curve giving these losses for various flows should be included in the specification.

(2) As previously pointed out, a diesel engine is not too satisfactory a pump drive for those pump stations that have limited sump capacity (such as in the instant case) and the pumps will be required to cycle "ON" and "OFF" every four to six minutes when the flows are less than the design flow. To alleviate this undesirable operating condition, a station bypass should be provided as described in subparagraph 6d of EM 1110-2-3102. The usable sump volume of the Main Street Station could be increased by the use of a longer pump column that would place the pump intake bell at the accepted distance above the sump floor.

(3) The size of the sump intakes should be increased.

f. Paragraph 26. All sluice gates should be provided with manually operated type floorstands and a portable power-driven wrench provided at each station for the operation of the sluice gates. Information covering this feature is given in paragraph 18c of EM 1110-2-3105, 10 December 1962.

g. Paragraph 27. In order to prevent damage to the fuel storage tank from corrosion, it should be placed in a covered concrete pit rather than buried in the ground. The pit should be provided with an adequate drain, the tank painted with a cold applied coal tar, placed on saddles and anchored, and the pit filled with coarse sand or pea gravel.

h. Paragraph 30. In view of the type heating system to be installed, dehumidification equipment should be provided to remove moisture from the station during inoperative periods. Information covering the design of the dehumidification facility is covered in paragraph 22 of EM 1110-2-3105.

i. Plate No. 6. Inclosed (Inclosure No. 2) is a copy of the specification for pumping station entrance doors to be used as a guide in the preparation of the specification covering doors for the subject pumping stations. This type door has been used by the St. Louis District in most of the pumping stations constructed as a part of the St. Louis Project.

j. Plate No. 7.

(1) Since it will be necessary to extend the excavation on the eastern side of the pump station to include the 30-inch R.C.P. bypass main, consideration should be given to extending the base slab approximately 8 feet

ENGCW-EZ (10 Apr 63)

1st Ind

10 May 1963

SUBJECT: Chicopee Falls Local Protection Project, Chicopee River,
Massachusetts - Design Memorandum No. 6 - Pumping Stations

outside of the station on this side so as to permit a reduction of approximately 14 feet in the long slab extension on the other side and to avoid encroachment of the excavation into the river channel. No major change in slab thickness or reinforcement is considered necessary.

(2) Stop log slots should be constructed using steel channels as indicated in green on the drawing (Inclosure No. 1). This type of slot should also be used on the Oak Street Station.

k. Page A-28. Consideration should be given to increasing the load on the landside wall to include passive pressure from the external earth to resist sliding.

FOR THE CHIEF OF ENGINEERS:

2 Incls

1. Plate No. 7 (marked in green)
2. Cy of Spec - Entrance Doors
(Incl 1 w/d)

for *W.H.E. Johnson*

Chief, Engineering Division
Civil Works

Mr. R. Sims/re

REMARKS

19 April 1943

SUBJECT: Chipping Falls Land Protection Project, Chipping River,
Massachusetts - Project Number 10, No. 6 - Pumping Station

E.H.

TO: Chief of Engineers
ARMED FORCES
Department of the Army
Washington 25, D. C.

Re. Re: made to our letter dated 20 April 1943, concerning
the subject number. Please note the corrections which should
be made therein:

Page 9 - Paragraph 22 is deleted in its entirety and the
following is substituted therefor: "Alternate Pump Drives. A cost
comparison to determine the most economical pump drive was made. Based
on these comparisons as shown below, Diesel engine drive was selected".

Page 32 - Paragraph 37 is deleted and the following is sub-
stituted therefor: "All interior and exterior
wiring is to meet a. Requirements are copper with insulation con-
forming to Civil Works Guide Specification C.W. 1101-41".

FOR THE ENGINEER DIRECTOR

John W. Leslie
Chief, Engineering Division

cc: Mr. Leslie
Mr. Croton
Mr. Coffin
Engg Div Files

U. S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS

DRESS REPLY TO:
DIVISION ENGINEER

REFER TO FILE NO.

NEDGW

10 April 1963

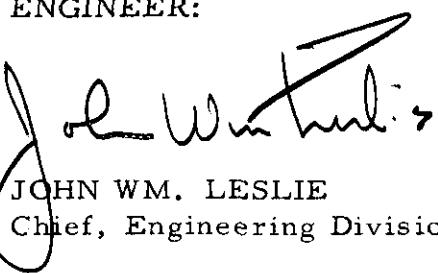
SUBJECT: Chicopee Falls Local Protection Project, Chicopee River, Massachusetts - Design Memorandum No. 6 - Pumping Stations

TO: Chief of Engineers
ATTENTION: ENGCW-E
Department of the Army
Washington 25, D. C.

There is submitted for review and approval Design Memorandum No. 6 - Pumping Stations, for the Chicopee Falls Local Protection Project, Chicopee River, Massachusetts, in accordance with EM 1110-2-1150. The contract award for construction of this project is scheduled for May, 1963, and an early receipt of your review comments will be appreciated in order that the plans and specifications may be completed on schedule.

FOR THE DIVISION ENGINEER:

Incl (10 cys)
Des. Memo No. 6


JOHN WM. LESLIE

Chief, Engineering Division

FLOOD CONTROL PROJECT
CHICOOPEE FALLS LOCAL PROTECTION PROJECT
CHICOOPEE RIVER
CHICOOPEE RIVER BASIN
MASSACHUSETTS

DESIGN MEMORANDA INDEX

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1	(Omitted)		
2	General Design, Hydrology, Hydraulics & Geology	21 Dec 1962	22 Jan 1963
3	Real Estate	29 Mar 1963	
4	Concrete Materials	9 Nov 1962	23 Nov 1962
5	Embankment & Foundations	6 Mar 1963	21 Mar 1963
6	Pumping Stations	10 Apr 1963	
7	Detailed Design of Flood- walls & Structures	13 Mar 1963	

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Appendix

- A. Structural Computations,
Main Street Pumping Station
- B. Structural Computations,
Oak Street Pumping Station
- C. Pump Selection

PLATES

Number

Title

- | | | |
|----|--------------------------|--------------------------|
| 1. | Location Plan | |
| 2. | Project Plan | |
| 3. | General Plan and Profile | Sta. 23+40 to Sta. 28+23 |
| 4. | General Plan | Sta. 45+45 to Sta. 49+61 |
| 5. | General Profile | Sta. 33+17 to Sta. 54+14 |

Main Street Pumping Station

- | | |
|-----|--|
| 6. | Architectural - Elevations |
| 7. | Architectural - Plans and Section |
| 8. | Structural - Reinforcing Details |
| 9. | Mechanical |
| 10. | Electrical Distribution One-Line Diagram |

Oak Street Pumping Station

- | | |
|-----|--|
| 11. | Architectural - Elevations |
| 12. | Architectural - Plans and Section |
| 13. | Structural - Reinforcing Details |
| 14. | Structural - Reinforcing Details |
| 15. | Mechanical |
| 16. | Electrical Distribution One-Line Diagram |

FLOOD PROTECTION

CHICOOPEE FALLS

LOCAL PROTECTION PROJECT

CHICOOPEE RIVER, MASSACHUSETTS

DESIGN MEMORANDUM NO. 9

PUMPING STATIONS

APRIL, 1963

A. PERTINENT DATA

a. <u>Number of Stations</u>	2 - Main and Oak Streets	
b. <u>Purpose</u>	To pass combined storm run-off, industrial waste water and sanitary sewage originating below the protection elevation through the dike and floodwall at high river stages.	
<u>c. Location of Stations</u>		
{1} State	Massachusetts	
{2} City	Chicopee	
{3} Area of City	Chicopee Falls	
{4} River	Chicopee River, left bank downstream from Deady Memorial Bridge.	
<u>Main Street Oak Street</u>		
d. <u>Drainage Area</u>	20.5A	17.8A
e. <u>Sanitary and Industrial Wastes</u>	4 c.f.s.	20 c.f.s. max.
f. <u>Allowance for Underseepage</u>	6 c.f.s.	6 c.f.s.

g. Pumping Stations

	Main Street	Oak Street
(1) Type	Wet Pit	Wet Pit
{2} Size	17'x21'	21'x28'
(3) Architectural Treatment	Concrete superstructures	
(4) Rated Capacity		
High River Stage	40.0 c.f.s.	46.6 c.f.s.
Low River Stage	44.0 c.f.s.	57.0 c.f.s.
(5) Pumps		
(a) Type	Mixed Flow	Axial Flow
(b) Number	2	3
(c) Size	16-inch (18-in. discharge)	16-inch (16-in. discharge)
(d) Performance, each, River at high stage		
1. Capacity	9000 gpm	7000 gpm
2. Static Head	19.4 ft.	21.1 ft.
3. Total Dynamic Head	21.4 ft.	23.5 ft.
(e) Performance, each, River at low stage		
1. Capacity	9900 gpm	8600 gpm
2. Static Head	7.7 ft.	7.0 ft.
3. Total Dynamic Head	10.1 ft.	10.8 ft.
(f) Drive		
1. Type	Diesel	Diesel
2. Horsepower	85 hp	75 hp
(6) Sump Water Elevations, MSL		
(a) Maximum w.l.	83.0	80.0
(b) Minimum w.l.	78.37	75.0

B. INTRODUCTION

1. Purpose. The purpose of this memorandum is to summarize and record the basic features of the design for two pumping stations for the Chicopee Falls Local Protection Project, to facilitate review and provide a convenient reference.

2. Scope. This memorandum presents basic design including preliminary plans and discussion. Design criteria, typical computations for pump sizes, station stability and stresses, and other pertinent data are included.

3. Construction Schedule. These stations will be constructed under a continuing type contract to be advertised in the Spring of 1963. The contract will include channel work, dikes, flood walls, etc., for the project. Construction of the pumping stations will be scheduled for 1963.

C. HYDROLOGY AND HYDRAULICS

4. Hydrology and Hydraulics are presented in Design Memorandum No. 2, General Design, Hydrology, Hydraulics and Geology, as are the Pumping Station Design Concepts summarized in A above.

D. GEOLOGY

5. General site geology is presented in Design Memorandum No. 2, General Design, Hydrology, Hydraulics and Geology.

6. The Main Street Station is founded on sound shale bedrock, as is the adjacent flood wall. Rock anchors are used to eliminate differential movement relative to the adjoining anchored tee walls.

7. The Oak Street Station is founded on granular soil, about three feet above a stratum of dense glacial till.

E. CONCRETE MATERIALS

8. Concrete Aggregate. Six commercial sources of sand and crushed stone were considered: five are recommended as satisfactory. A complete discussion of sources and costs with test results is included in Design Memorandum No. 4, Concrete Aggregates.

F. ARCHITECTURAL DESIGN

9. General. Architectural design of the pumping stations is in accordance with the Engineering Manual, EM 1110-2-3103, "Architectural Design of Pumping Stations," dated February 1960. Architectural treatment is shown on Plates 6, 7, 10 and 11.

10. Architectural Design. The superstructures of the pumping stations are cast-in-place reinforced concrete. The roofs are pitched to the pump discharge chambers, which are carried full height of the building. Roof construction is concrete slab with rigid insulation and 5-ply built-up roofing. Access to the roofs is by interior ladder. Stop log storage is provided on the roofs. Metal cabinet enclosures are used to provide security for the sluice gate operators.

G. STRUCTURAL DESIGN

11. General. This section presents the design criteria, basic data and assumptions used in the design of the pumping stations. A brief discussion of the stations is included as background for the structural computations which are presented in Appendices A and B.

12. Design Criteria.

a. General. All working stresses conform to those specified in the Engineering Manual for Civil Works, EM 1110-1-2101, "Working Stresses for Structural Design" dated 6 January 1958. Loading conditions, design assumptions, and other design criteria are based on the following applicable parts of the Engineering Manual for Civil Works: Standard Practice for Concrete (EM Part CXX - October 1953); Pumping Stations - Structural Design (EM 1110-2-3104 - 9 June 1958); and Wall Design - Flood Walls (EM 1110-2-2501 - January 1948 with changes 1 and 2 and Supplement). Accepted practice has been followed where the Engineering Manual for Civil Works does not apply.

b. Concrete. The following table lists the concrete and reinforced concrete working stresses used in the design of structures.

<u>Description</u>	<u>p.s.i.</u>
(Based on $f_c = 3,000$ p.s.i.)	
<u>Flexure</u> - (f_c)	
Extreme Fiber stress in compression	1050

<u>Description</u> (Cont'd)	<u>p.s.i.</u>
<u>Shear</u> - (v)	
Beams - no web reinforcement	90
Beams with properly designed web reinforcement	240
Flat Slab at critical section	90
<u>Bond</u> - (u)	
Deformed Bars	
Top bars	210
All others	300
<u>Bearing</u> - (f_c^f)	
Load on entire area	750
Load on 1/3 area or less (Maximum permissible)	1125
(When loaded area is greater than 1/3, the stress coefficient should vary linearly between the above values.)	
<u>Modular Ratio</u> - (n)	10

c. Reinforcement.

(1) Grade and Working Stresses. All reinforcement in the structures including temperature and shrinkage reinforcement is designed for the working stresses of new billet steel, intermediate grade, deformed bars: 20,000 p.s.i. in flexural tension. Reinforcement will conform to the requirements of Federal Specifications QQ-S-632, Type II and to ASTM A305.

(2) Spacing. The clear distance between parallel bars will not be less than 1-1/2 times the diameter of round bars except that in no case will the clear distance between parallel bars be less than one inch, or 1-1/2 times the maximum size of the coarse aggregate whichever is greater.

(3) Minimum Cover for Main Reinforcement

	<u>Min. Cover</u> (Inches)
Bottom of base slabs	4
Top of base slabs	3
Foundation walls, both faces	3
Exterior walls above grade	2
Floor and roof slabs	3/4
Interior girders	2
Interior floor beams	1-1/2

The concrete covering of stirrups, spacer rods, and similar reinforcement may be reduced by the diameter of such rods.

(4) Splices. All splices are lapped 24 diameters to develop, by bond, the total working strength of the bars. Splices in the main reinforcement at points of maximum moment are avoided in the design.

(5) Temperature and Shrinkage Reinforcement. Temperature and shrinkage reinforcement is provided in slabs and walls where the main reinforcement extends in only one direction. Such reinforcement, based on deformed bars, provides for a minimum ratio of steel area to concrete area (bd) of 0.002 with a minimum of .001 in each face up to a maximum of #6 bars @ 12" center-to-center.

d. Structural Steel. Structural steel is designed in accordance with the specifications for the Design, Fabrication and Erection of Structural Steel for Buildings, issued by the American Institute of Steel Construction. Allowable design working stresses conform to those given in the Engineering Manual for Civil Works using a basic stress of 20,000 p.s.i.

e. Increase in Normal Working Stresses. Normal allowable working stresses will be increased by 33-1/3 per cent for water at the top of the flood wall.

13. Basic Data and Assumptions.

<u>a. Controlling Elevations</u>	<u>Main St.</u>	<u>Oak St.</u>
Engine room floor slab	90.0	86.06
Sump floor slab	74.0	73.0
Water elevation riverside	102.0	97.0
Water elevation landside	88.5	83.5
Maximum elevation of water in sump	83.0	80.0
Minimum elevation of water in sump	78.37	75.0
Finished ground elevation	88.5	83.5-89.0

b. Loads

(1) Dead Loads. The following unit weights for materials have been used:

<u>Material</u>	<u>Pounds per cubic foot</u>
Water	62.5
Dry earth	125
Saturated earth	135
Submerged earth	72.5
Concrete	150

(2) Live Loads. The following live loads have been used:

	<u>Pounds per square foot</u>
Wind	50
Equipment	As furnished by manufacturers
Snow on roof	40
Engine room floor	100 plus equipment loads

c. External Water Pressure. In cases where hydraulic pressure affects the design of a structure, it has been assumed to act over the entire area in question under the full head available. Specific uplift assumptions for the structure are described in a later paragraph.

d. Earth Pressure. Earth pressure against the pumping station walls has been assumed at 40 lbs. per square foot equivalent liquid pressure for dry earth and 24 lbs. per square foot for submerged earth.

14. General Description of Pumping Stations.

a. General. The pumping stations consist of reinforced concrete structures. Discharge chamber required top elevations are nearly at the roofs; they are, therefore, carried to the full building height. Both stations contain gravity by-pass, wet sumps, engine rooms and discharge chambers. Sluice gates are seating type against river pressures. Stop log slots are provided in the discharge chamber to allow pumps or flap valves to be removed for servicing.

b. Main Street Pumping Station. This station is an integral part of the flood wall. The station is located in the yard of the Chicopee Manufacturing Company.

c. Oak Street Pumping Station. This station is located on the landside of the dike. It is on the riverside of the existing river wall at the U. S. Rubber Company.

15. Extent of Design. Design has been carried to an extent which determined a workable layout. A transverse section through the station has been designed for the maximum conditions affecting critical structural framing. The same design procedure will be followed wherever a change in loading or in section is made. Modifications will be made as prescribed by detailed layout and design.

16. Superstructure. The roof slabs are 6-inch, 2-way slabs supported on reinforced concrete walls. Crane loads are carried directly by the concrete walls. Impact load of the cranes is taken as 25% and lateral load is 20% of the live load.

17. Engine Room Floor. Live load on engine room floors is taken as 100 p.s.i. plus equipment concentrations. Slab is of uniform (12") thickness at Main Street. A beam-and-slab arrangement was used at Oak Street.

18. Substructure. Substructures are of reinforced concrete consisting of intake chambers, junction chambers, discharge chambers and sumps. Loads consist of horizontal earth and water pressures, bearing pressures and hydraulic uplifts. Hydrostatic head was determined by the line of creep method for design river levels, with tailwater at ground level. Substructures were designed as monolithic. The Main Street Station adjoins flood walls with rock anchored footings; for this reason, the station base slab is anchored to the rock to limit creep of the structure to match the walls.

19. Trash Racks. Steel trash racks have been provided in the intake chambers, with provision for raking. Racks are designed for full hydrostatic pressure halfway to the top of the chambers.

H. MECHANICAL DESIGN

20. General. This section presents pertinent information concerning the mechanical design of the pumping stations, including pumps, drives, cranes, gates and heating.

21. Pump Drives. Pumps are driven by industrial diesel power units capable of operating the pumps at rated speed at any head conditions that may develop. Required horsepower is less than the continuous engine rating. Drives are mounted on concrete bases and connected to right angle gear units through flexible couplings.

22. Alternate Pump Drives. Consideration was given to provision of reliable electric service from commercial power with dual service or standby power. Due to the length of secondary between stations and from the stations to a reliable underground source, diesel drives are substantially less expensive:

Diesel drives, gear units, fuel systems, aerial service for lighting, etc., for all units at both stations.	\$29,300
---	----------

Single aerial power service, transform- ers, switch gear, starters, motors, etc., plus diesel generator sets at each station	\$61,000
--	----------

Dual underground service, transformers, switch gear, starters, motors, etc. This includes savings due to reduction in building size.	\$72,500
---	----------

An important consideration in these small stations was the flexibility of operation provided by the variable speed available with diesel drives with adjustable governors. A curve sheet showing the effect of varying speed is included in Appendix C for each station, for the pump selected.

23. Right Angle Gear Units. The gears are of the self-contained type designed for transmitting power from the horizontal engine shaft through a gear train to the vertical pump shaft. The units are enclosed in a cast-iron and structural steel housing and have service factors of not less than 1.25 times the maximum power required to drive the pumps.

24. Pumps.

a. Main Street Station. Two pumps are required. To provide a reasonable capacity in the event of failure of a pump, two 16-inch mixed-flow pumps with a combined capacity of 40.0 c.f.s. against high river stage are provided. Design concepts for both stations are discussed in detail in Design Memorandum No. 2, "General Design Hydrology, Hydraulics and Geology."

b. Oak Street Station. Three 16-inch axial-flow pumps are required at this station to pass maximum process water flow plus storm water from a rainfall approaching a five-year storm at high river stage. At all river stages not requiring pumping of the process water from intermediate plant levels, there is a capacity for pumping storm runoff of 100-year frequency or more.

c. The type, size and general characteristics of pumps required were computed by the procedures outlined in EM 1110-2-3105 dated 10 December 1962. Computations are appended as Appendix C.

25. Crane. A two-ton overhead crane is provided in the engine room of each station to facilitate moving or repair of equipment. Cranes are of standard construction, hand-operated throughout.

26. Sluice Gates. Motor operated sluice gates will be located at the entrance of the sumps; these will be normally closed, except when pumping. Gates on the riverside of the by-pass

opening into the discharge chamber will normally be open except when pumping. At Oak Street, a third gate is provided to allow flows of process water from intermediate levels to by-pass the station while flows from lower areas are pumped. This gate will normally be open when not pumping, closed when pumping against low or moderate river stages, and open at high river stages.

27. Diesel Fuel System. Diesel fuel supply is stored in tanks, buried in the ground adjacent to the pumping stations; approximately 600 gallons at each station. Each engine is supplied through an individual line running directly to the tank. Drip pans are provided on each engine and connected to a common header running back to the tank. All fuel pipe is copper tubing with flared joint connections. At points where lines are embedded in concrete or pass through walls, they are protected by wrought-iron sleeves.

28. Sump Pump. Motor operated sump-pumps of 50 g.p.m. capacity are provided in the wet sumps for the purpose of drying them up after the pumping stations have been in operation.

29. Valves. A flap valve is installed on the end of each pump discharge line to facilitate the starting of the pump and to prevent backflow through it when the river is at flood stage. Stop log slots and logs are provided to close pump discharge lines in the event of flap valve failure.

30. Heating System. The heating system consists of electric powered unit heaters, sized for 50° F. temperature rise. Control is by thermostat with an overriding humidistat, to keep the temperature above the dew point. The use of diesel-oil fired unit heaters was considered with a resulting saving of \$400 per year in power costs. However, the City Engineer requested that electric heat be provided to reduce maintenance inspection costs.

I. ELECTRICAL DESIGN

31. Electric Service. Electric service from the City of Chicopee Electric Light Department is overhead from a pole at Blake and Main Streets. The Municipal Electric Light Department has proposed to install electric service for \$3,800.

Service poles and transformers will be the responsibility of the Electric Light Department. Service is 120-/240 three wire, single phase, 60 cycle.

32. Distribution. Utility secondary metering and a service entrance breaker is installed at the pumping station. A panel is furnished to serve motor, small power, lighting and receptacle loads in the pumping station. The wiring diagram is shown on Plates 10 and 16.

33. Telephone Service. Conduit, pull wire, and terminal box is provided for the installation of telephone service by the New England Telephone and Telegraph Company.

<u>34. Motors.</u>	<u>Main Street</u>	<u>Oak Street</u>
Floor stands	2 @ 1 HP	3 @ 1 HP
Wet sump exhaust fan	1 @ 1/7 HP	1 @ 1/7 HP
Sump pump	1 @ 2 HP	1 @ 2 HP
Heating Unit	1 @ 7.5 KW	1 @ 15 KW

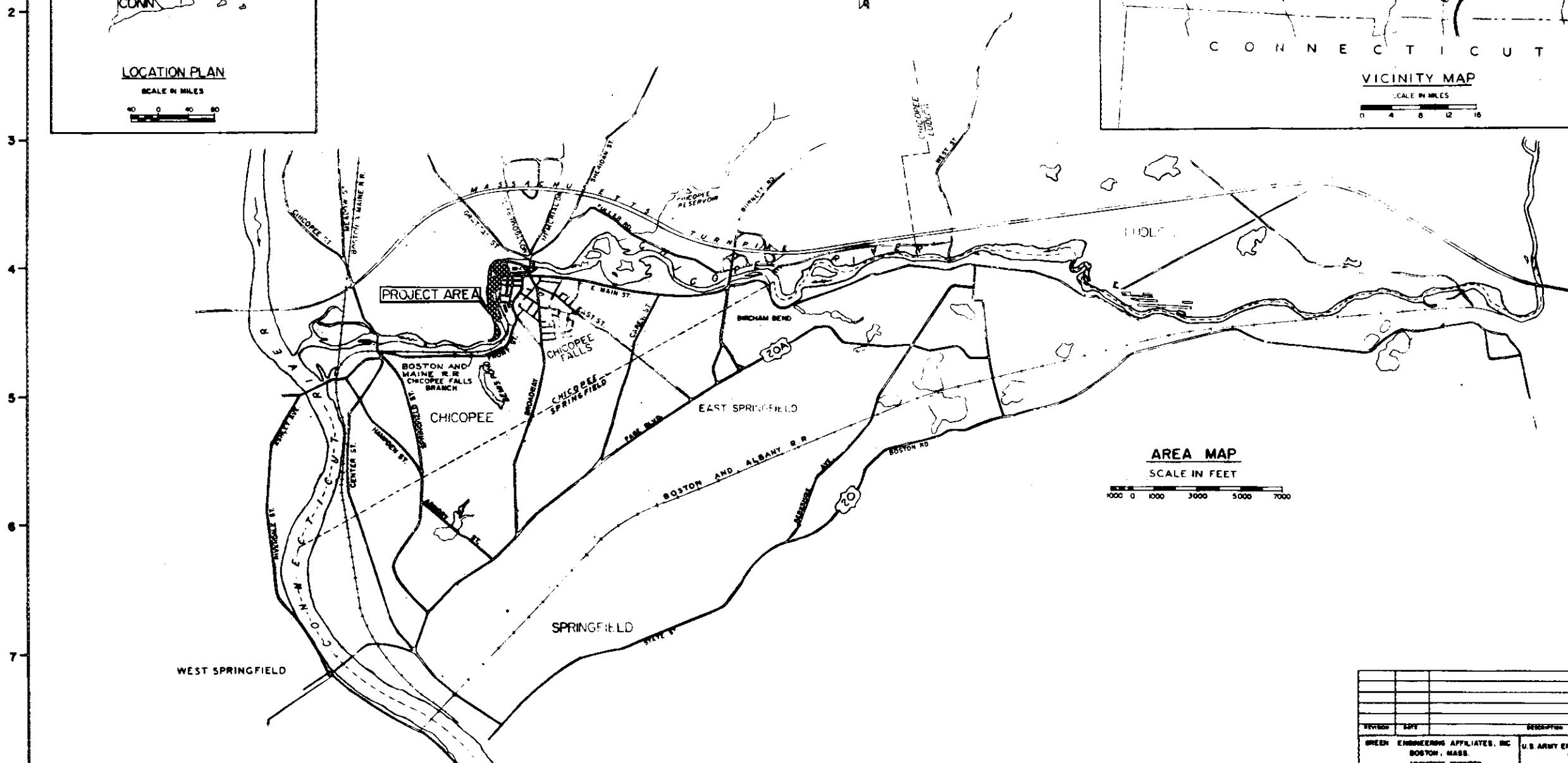
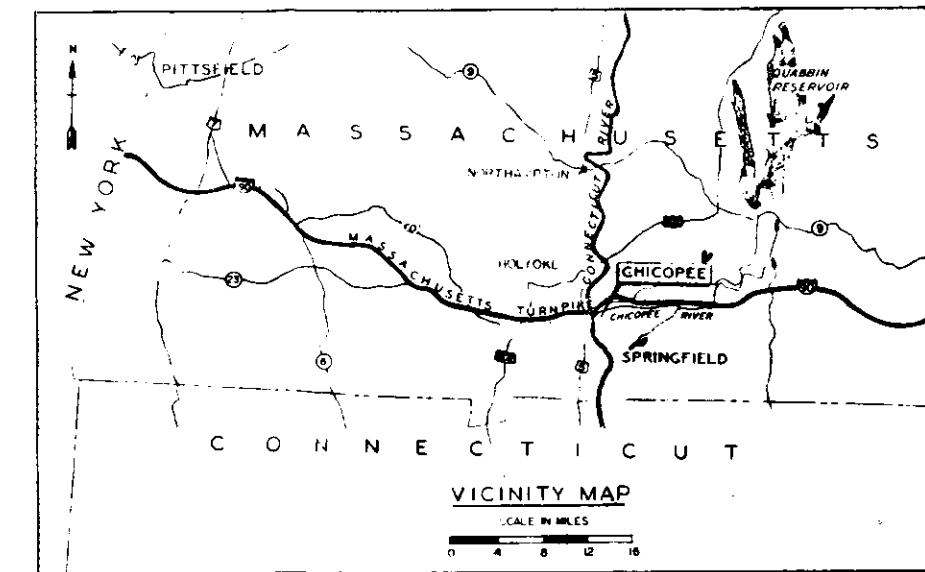
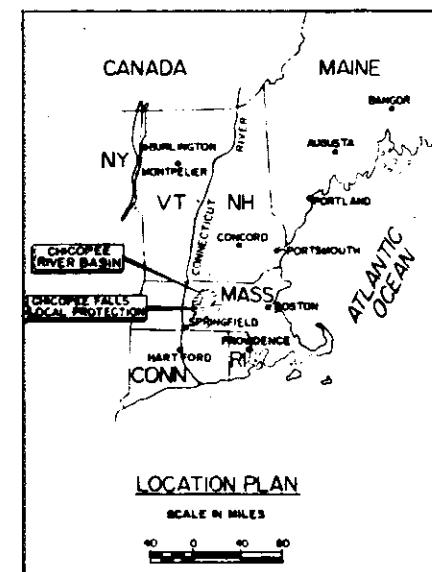
35. Heating. The unit heater with blower is thermostatically controlled with overriding humidistat.

36. Ground System. All conduit, equipment and the neutral conductor are grounded in accordance with the National Electric Code.

37. Conduit and Cables. All interior and exterior wiring are in steel conduit. Copper conductors with 600-volt RHW insulation is used for all wiring.

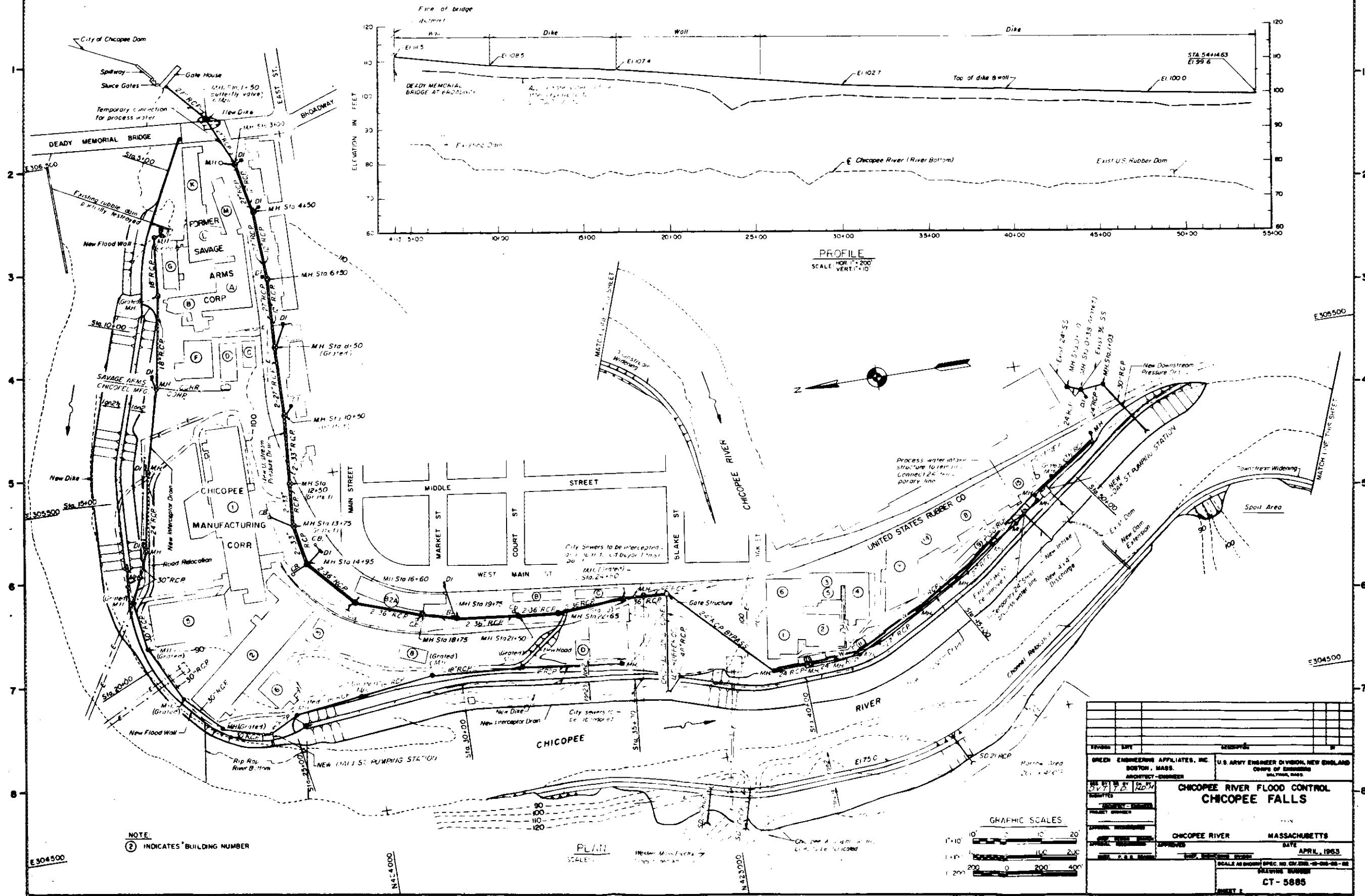
38. Motor Controllers. Motor controllers suitable for the intended application are installed as required.

39. Electrical Load. The electrical load is expected to create an estimated maximum demand of 11 KW at Main Street and 18 KW at Oak Street.



REVISION DATE		DESCRIPTION		BY
GREEN ENGINEERING AFFILIATES, INC. BOSTON, MASS. ARCHITECT-ENGINEER		U.S. ARMY ENGINEER DIVISION, NEW ENGLAND COPIES OF ENGINEERS WALTHAM, MASS.		
DES BY	DATE	CH.	BY	
GATED		HOM		
SUBMITTED				
ARCHITECT-ENGINEER				
PROJECT ENGINEER				
DRAWING NUMBER				
CIVIL DESIGN CHECK				
SPECIAL REQUIREMENTS				
SHEET 2 OF 2 SHEETS				
CHICOPPEE RIVER FLOOD CONTROL CHICOPPEE FALLS				
LOCATION PLAN				
CHICOPPEE RIVER MASSACHUSETTS				
APPROVED DATE 1963				
CIVIL ENGINEERS, INC.				
SCALE AS SHOWN SPEC. NO. CIV. ENG. 10-000-				
DRAWING NUMBER				
INDEX				

PLATE NO. 1



NOTE:
② INDICATES BUILDING NUMBER

1

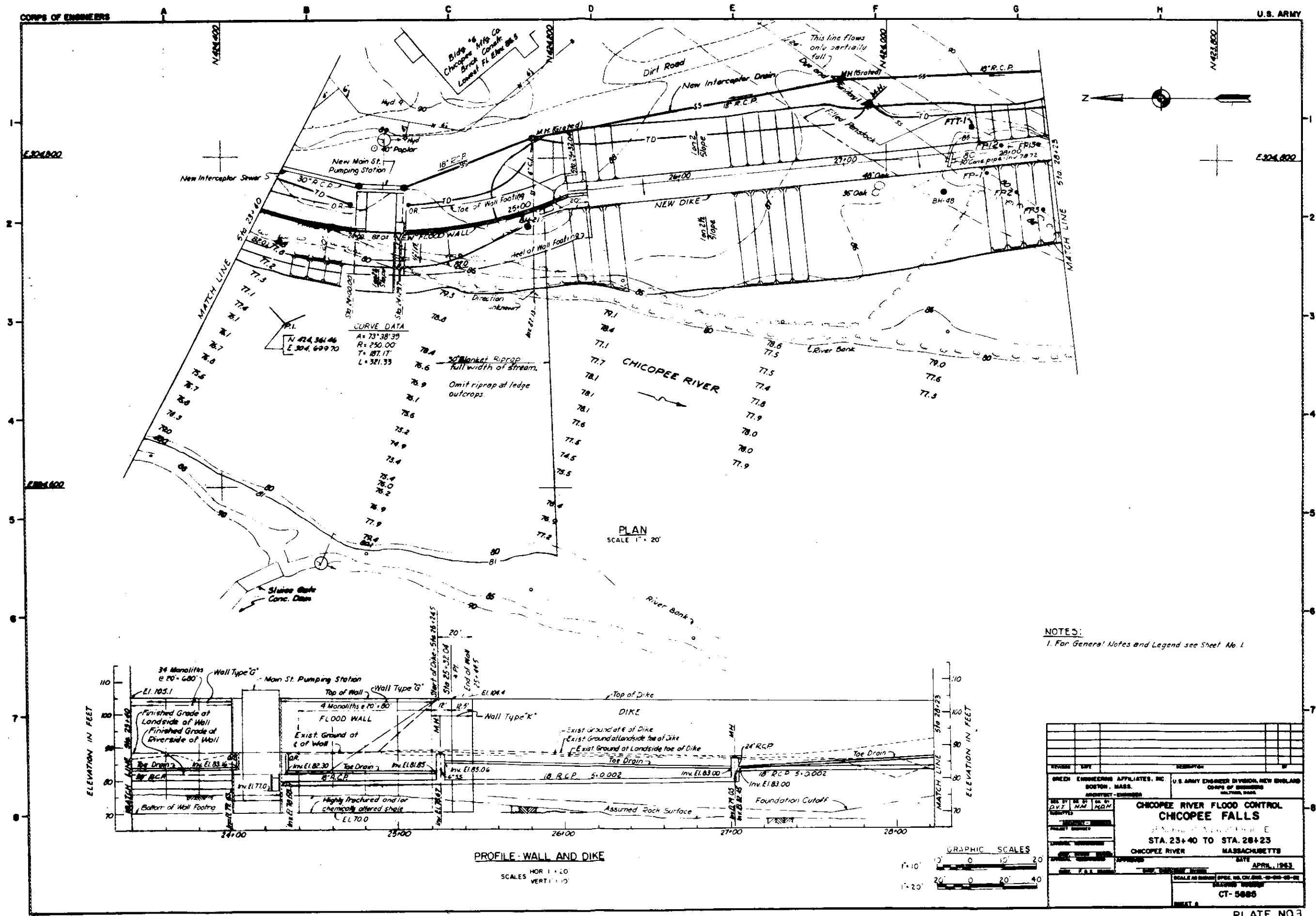
PLAN

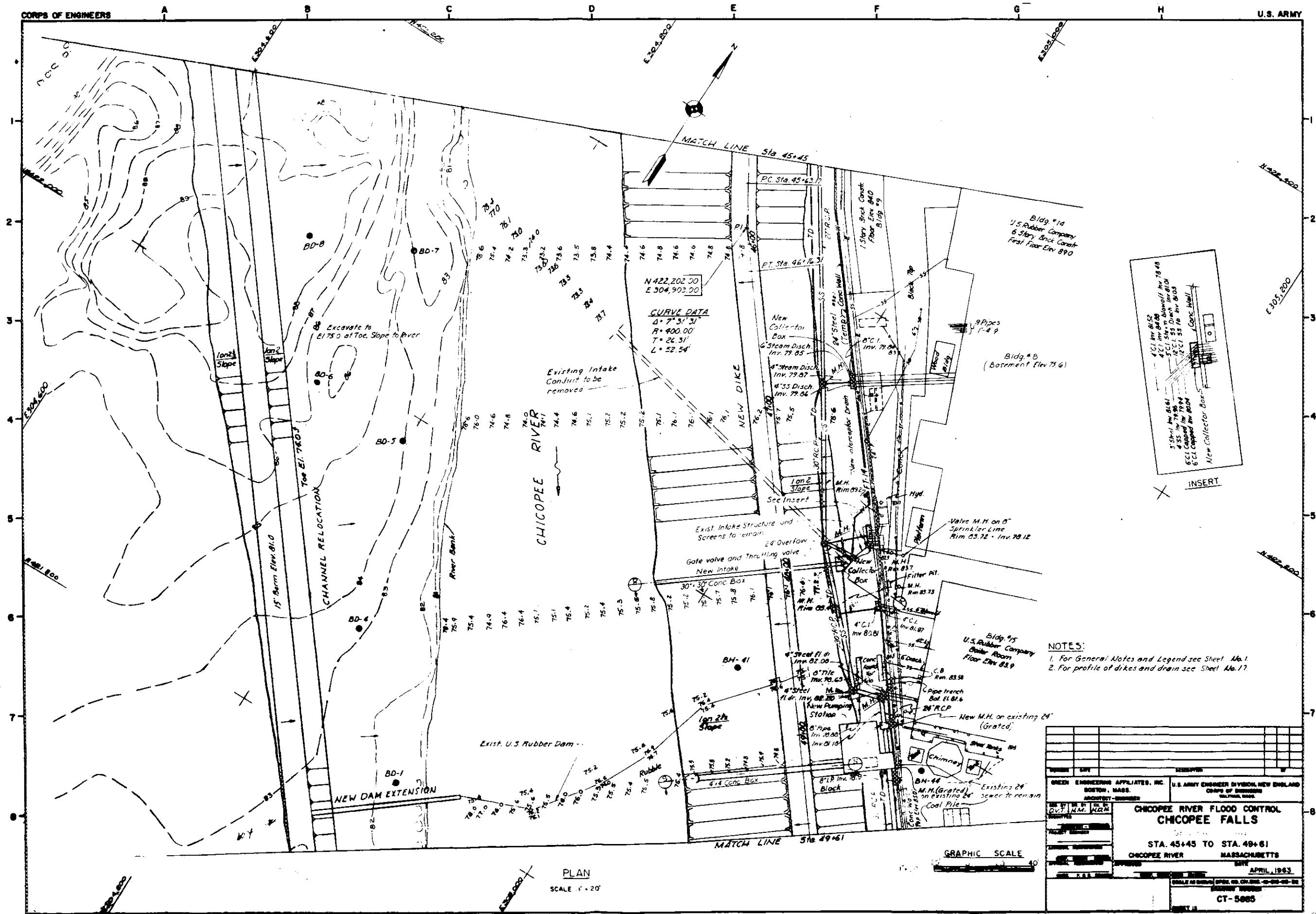
GRAPHIC SCALE

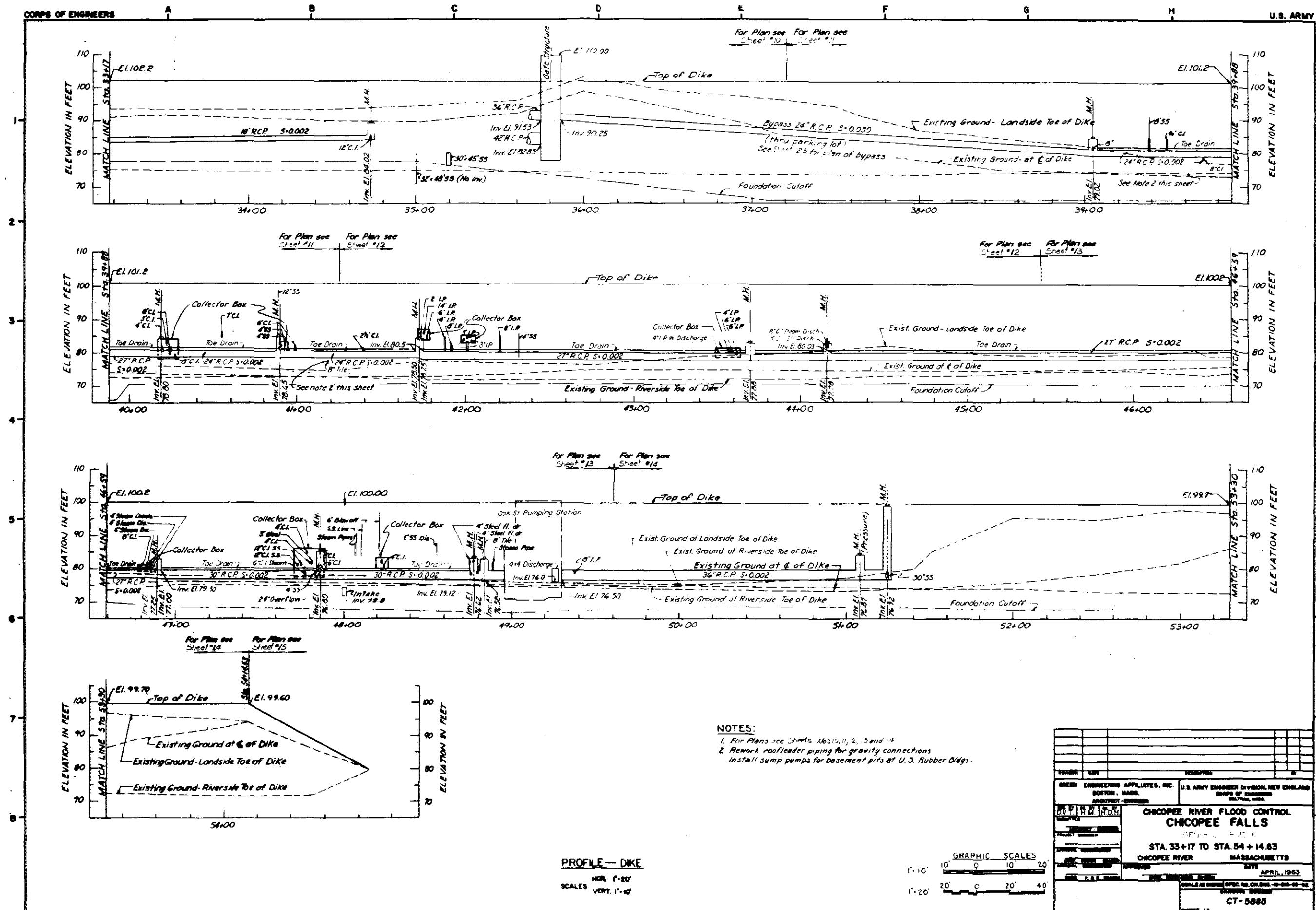
PLATE NO. 2

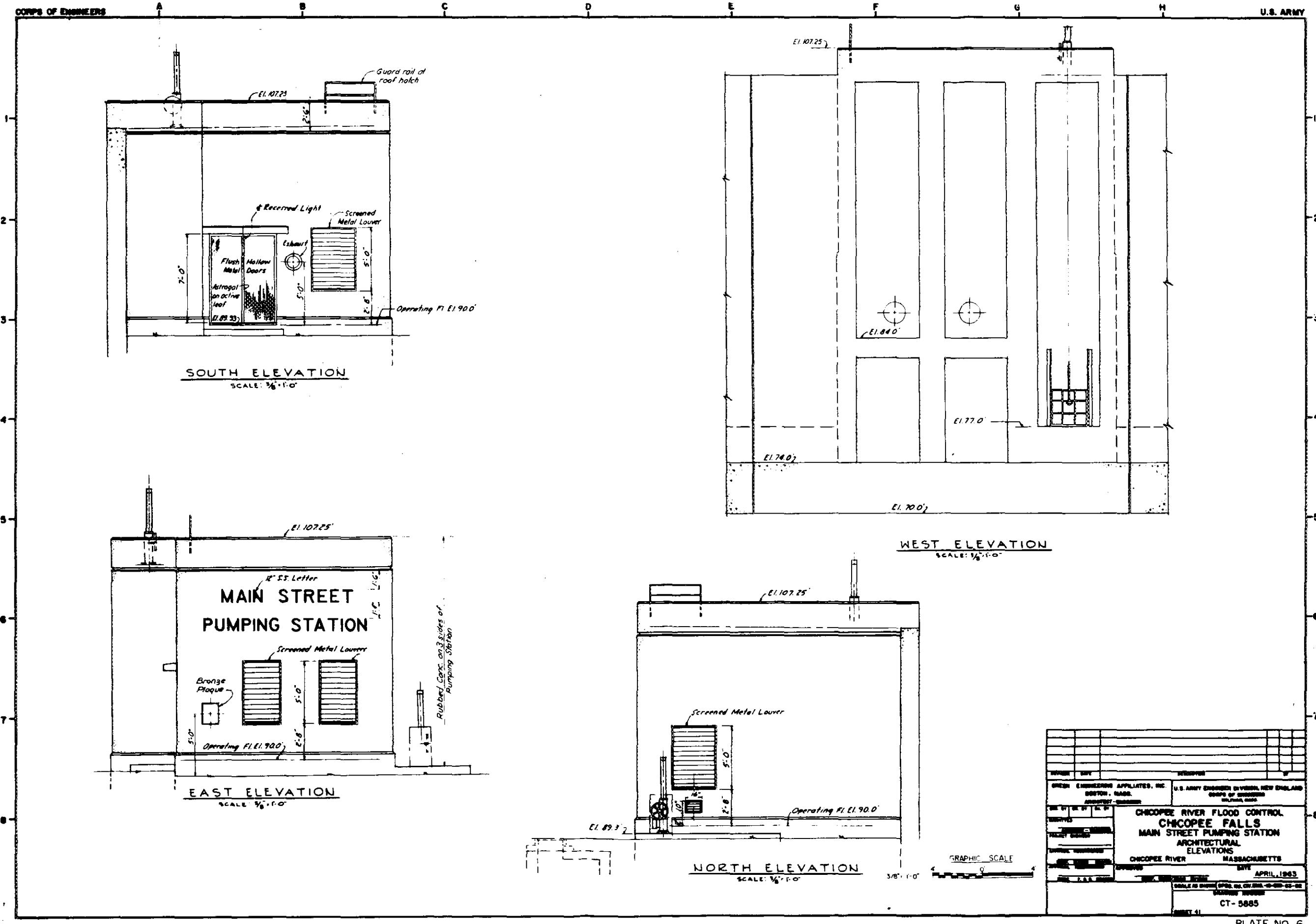
CORPS OF ENGINEERS

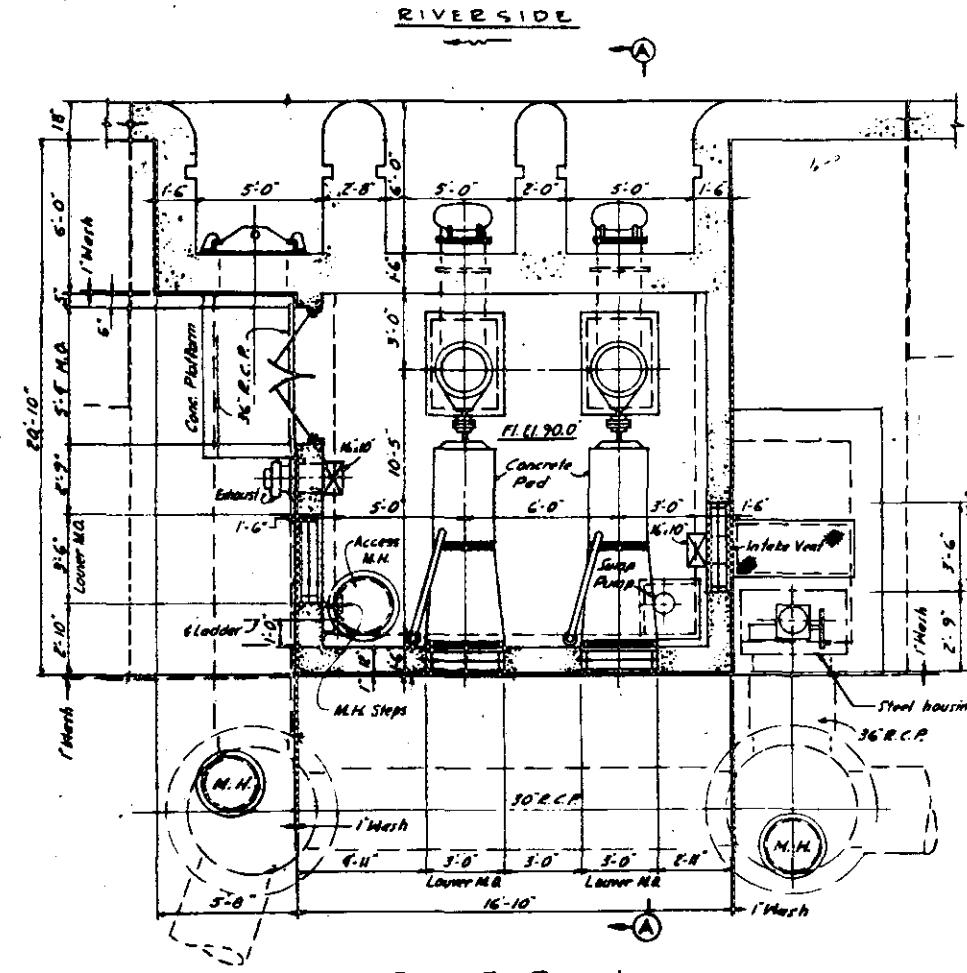
U.S. ARMY





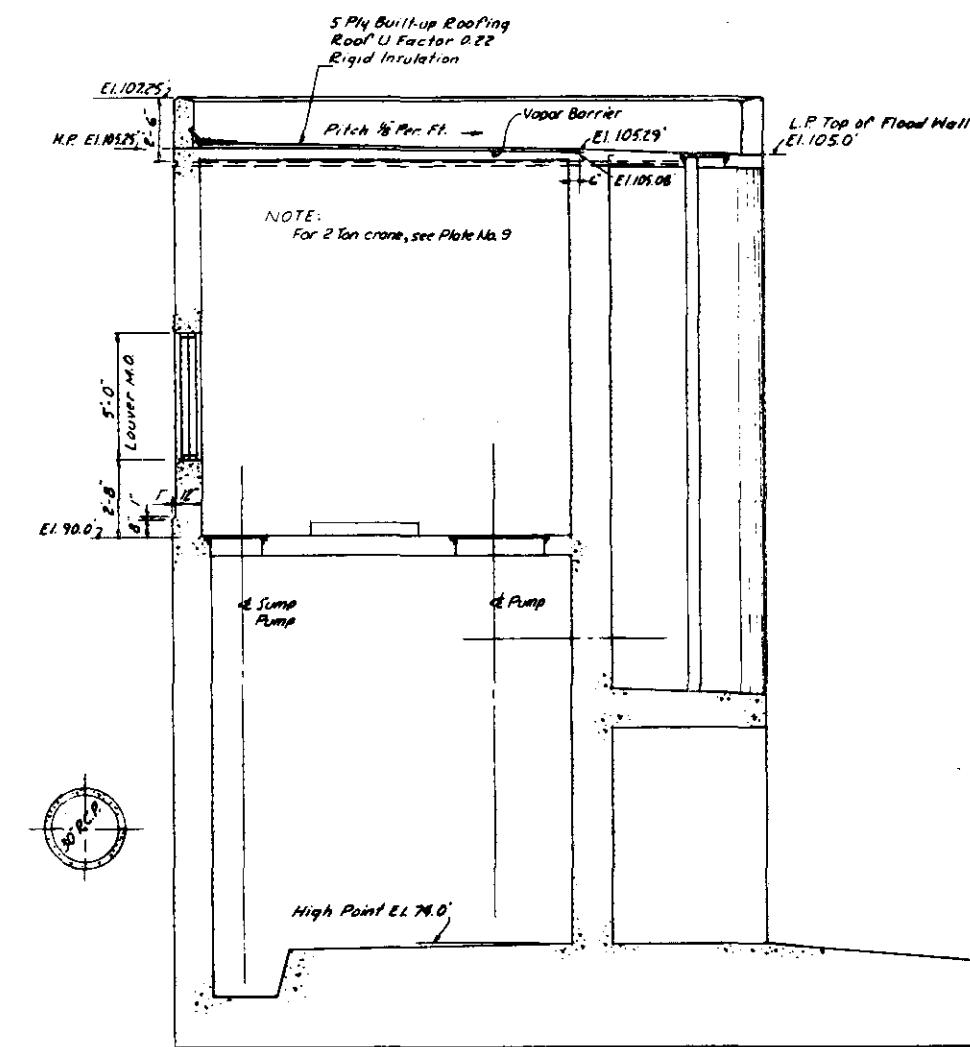






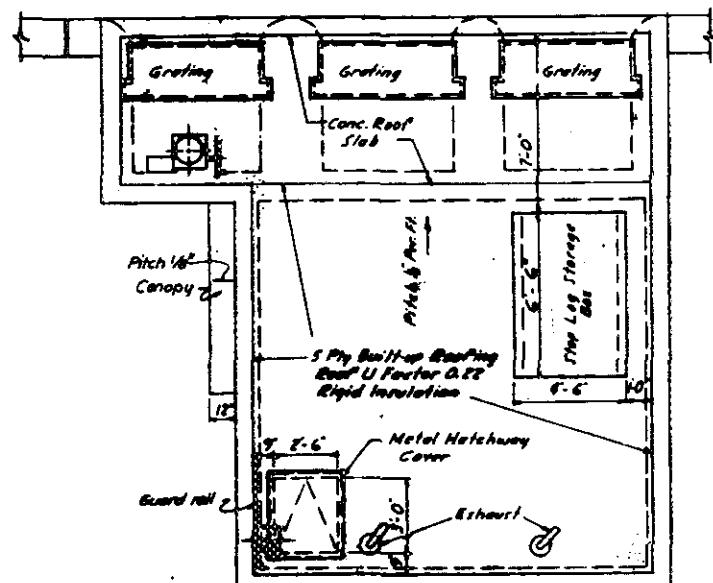
FLOOR PLAN

卷之三



SECTION A-A

SCALE: $\frac{1}{8}$ " = 1'



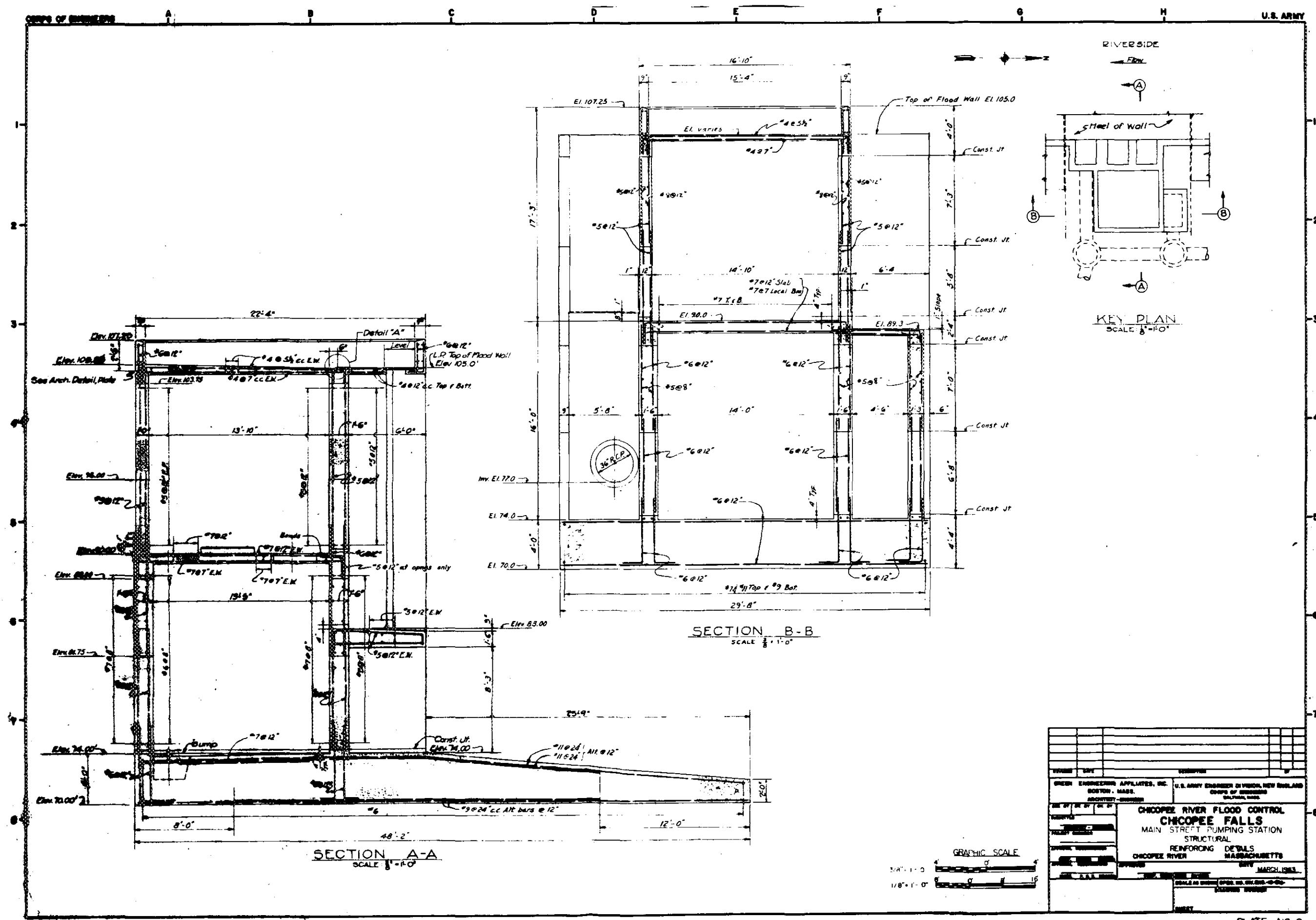
ROOF PLAN

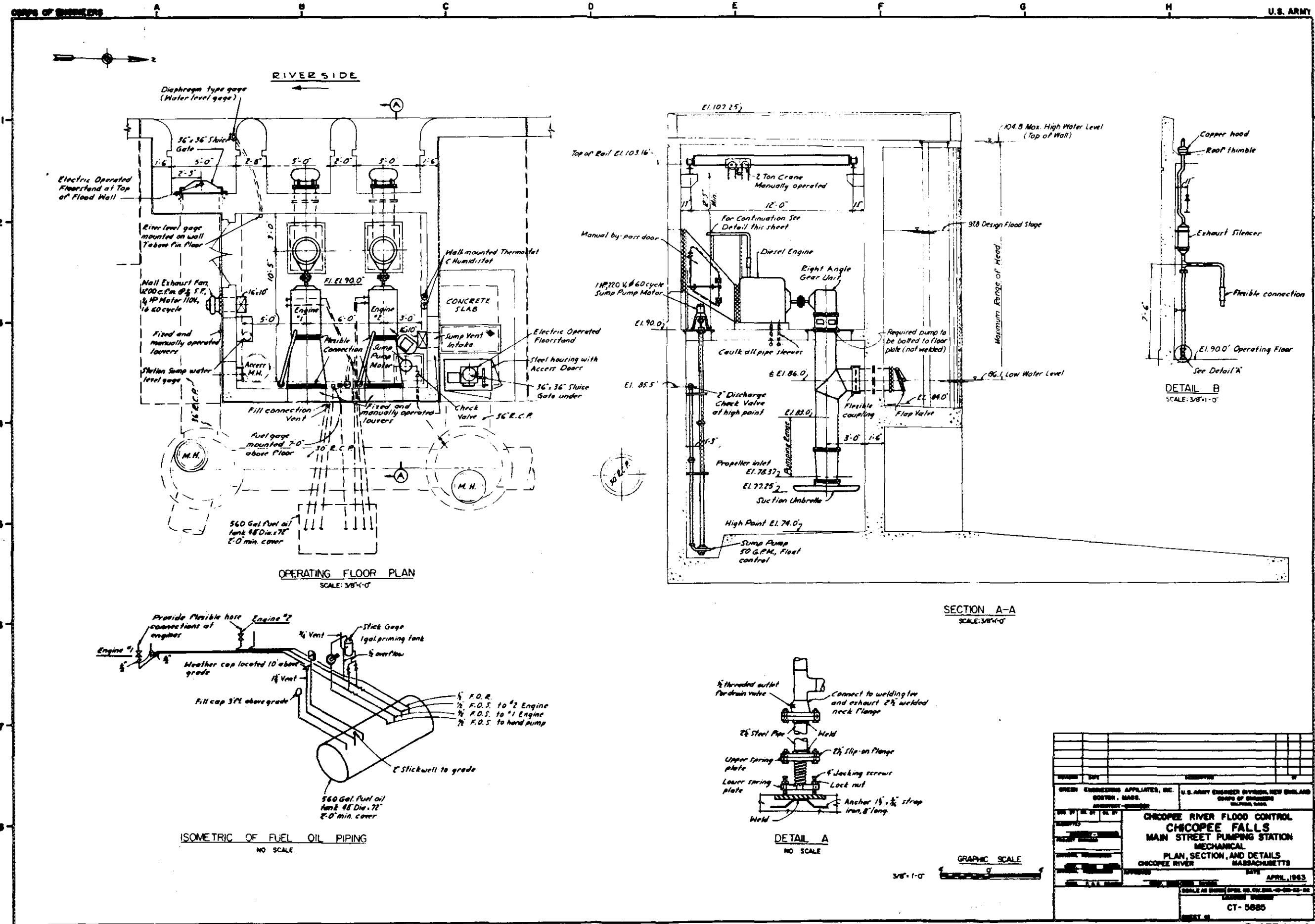
SCALE: 3 ft. or

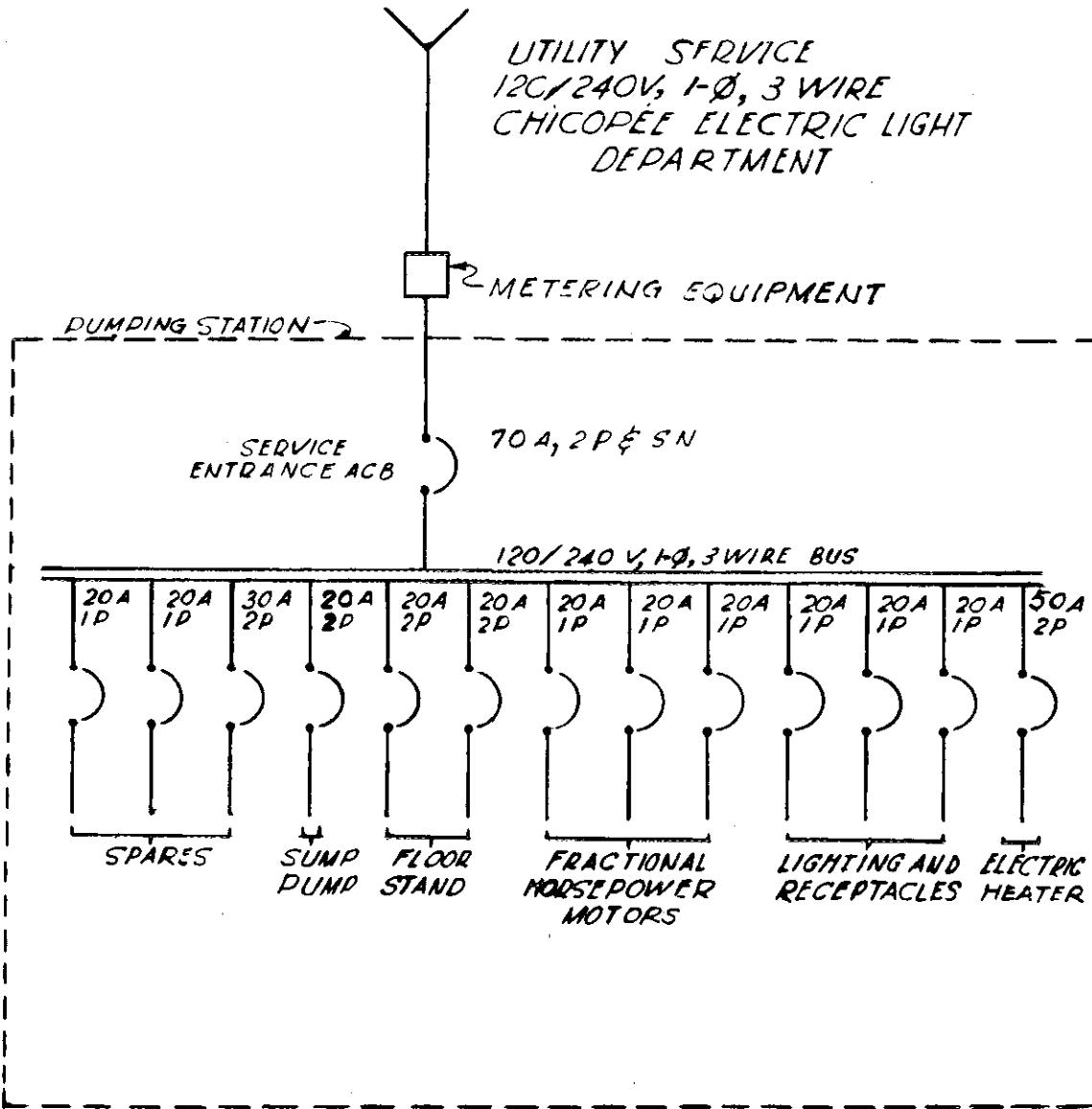
REVIEWED		APR 2	REVIEWER	W
GRIER ENGINEERING AFFILIATES, INC.		BOSTON, MASS.	U.S. ARMY ENGINEER DIVISION, NEW ENGLAND CHIEF OF ENGINEERS WALTHAM, MASS.	
ARCHITECT-ENGINEER				
FILE NUMBER	10-17	CHICOOPEE RIVER FLOOD CONTROL CHICOOPEE FALLS MAIN STREET PUMPING STATION ARCHITECTURAL PLANS AND SECTION CHICOOPEE RIVER MASSACHUSETTS		
OWNER	CHICOOPEE RIVER	DATE MARCH 1963		
PERMIT NUMBER				
APPROVED		SCALE AS SHOWN SHEET NO. ONE OF 10-170-1 DRAWING NUMBER		
GRIER, E. S. & ASSOCIATES				

GRAPHIC SCALE

PLATE NO. 7



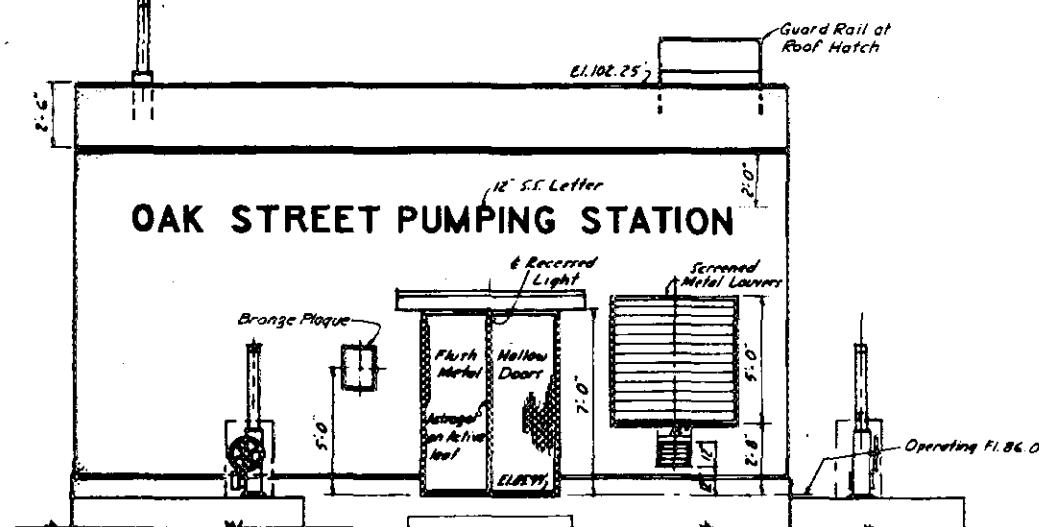




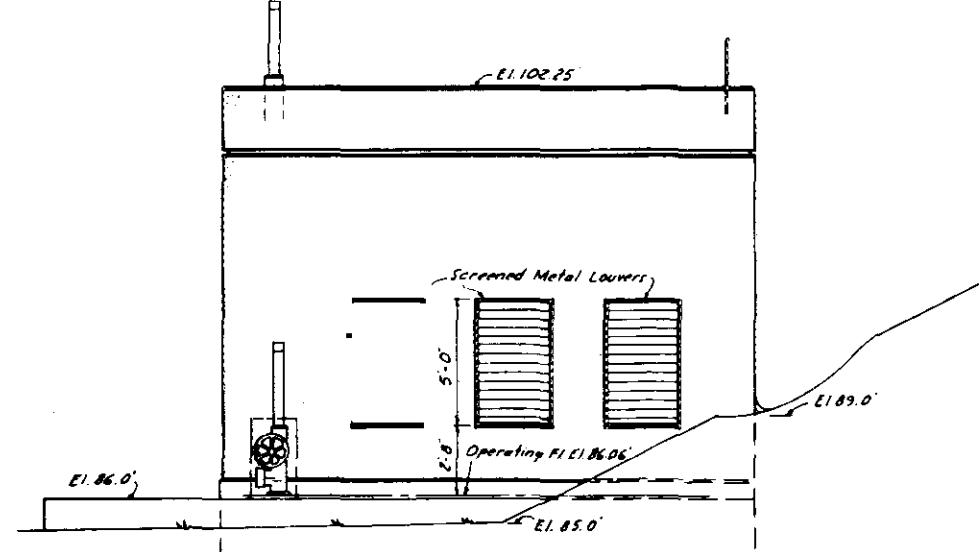
MAIN ST. PUMPING STATION

ELECTRICAL DISTRIBUTION
ONE-LINE DIAGRAM

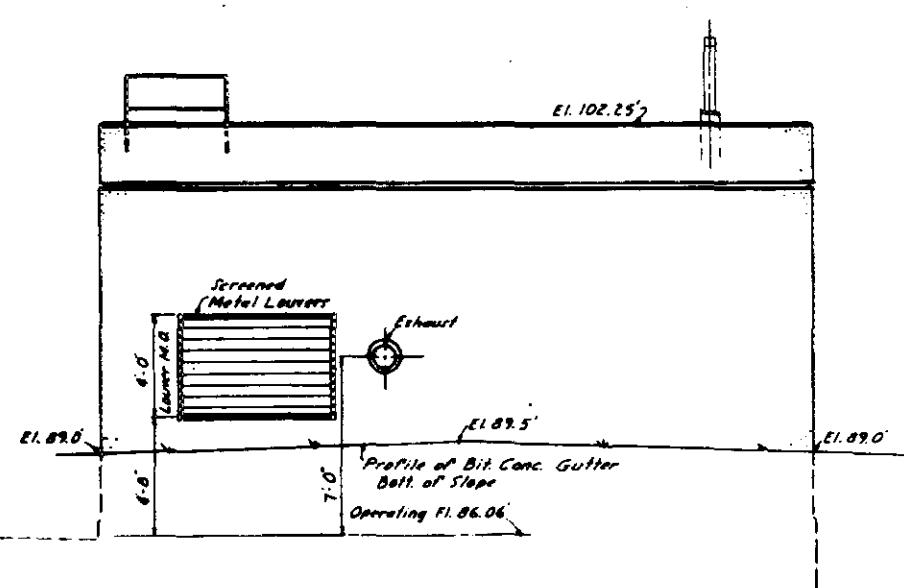
PLATE NO.10



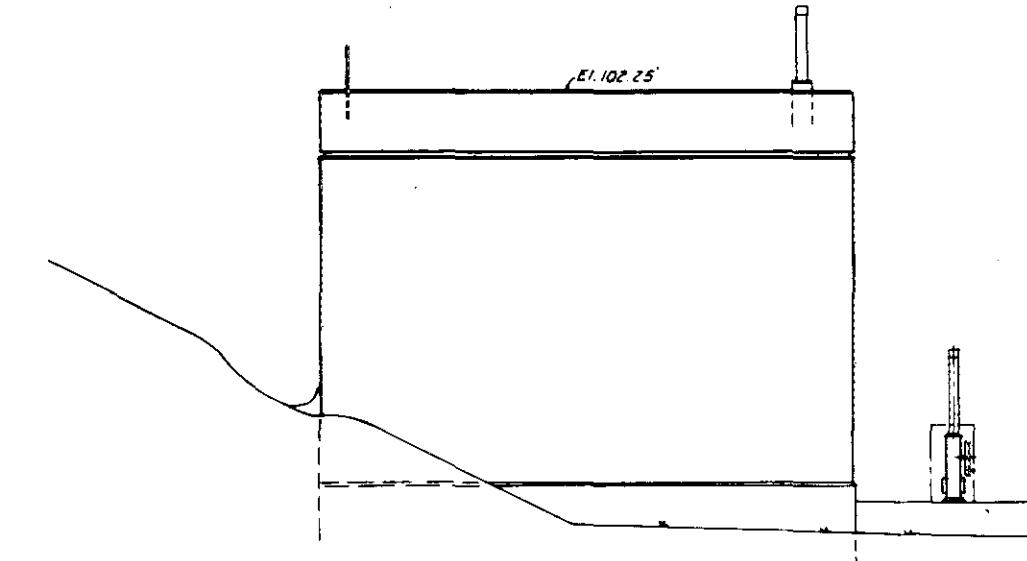
EAST ELEVATION

SCALE: $\frac{1}{8}$ "=1'-0"

NORTH ELEVATION

SCALE: $\frac{1}{8}$ "=1'-0"

WEST ELEVATION

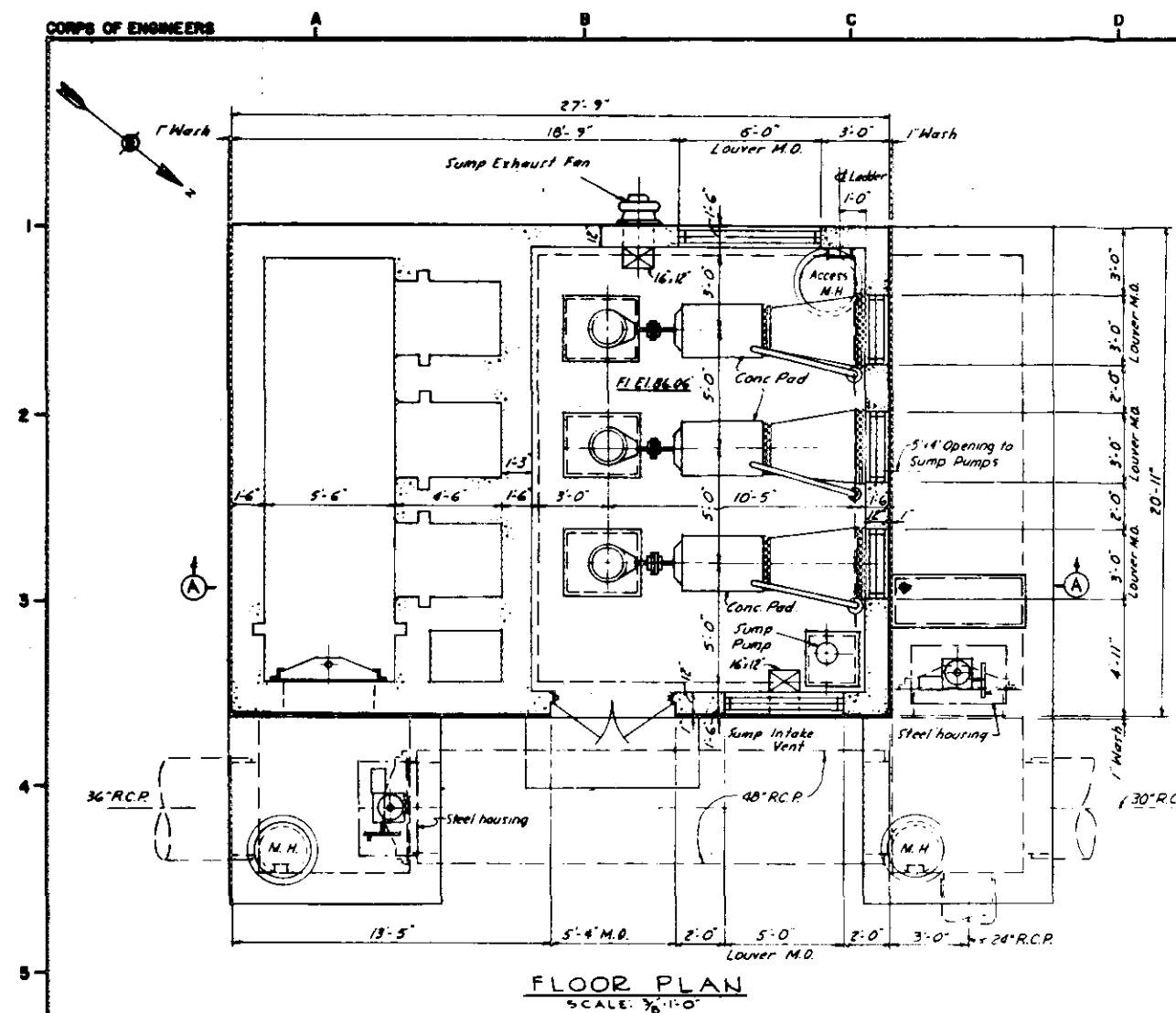
SCALE: $\frac{1}{8}$ "=1'-0"

SOUTH ELEVATION

SCALE: $\frac{1}{8}$ "=1'-0"

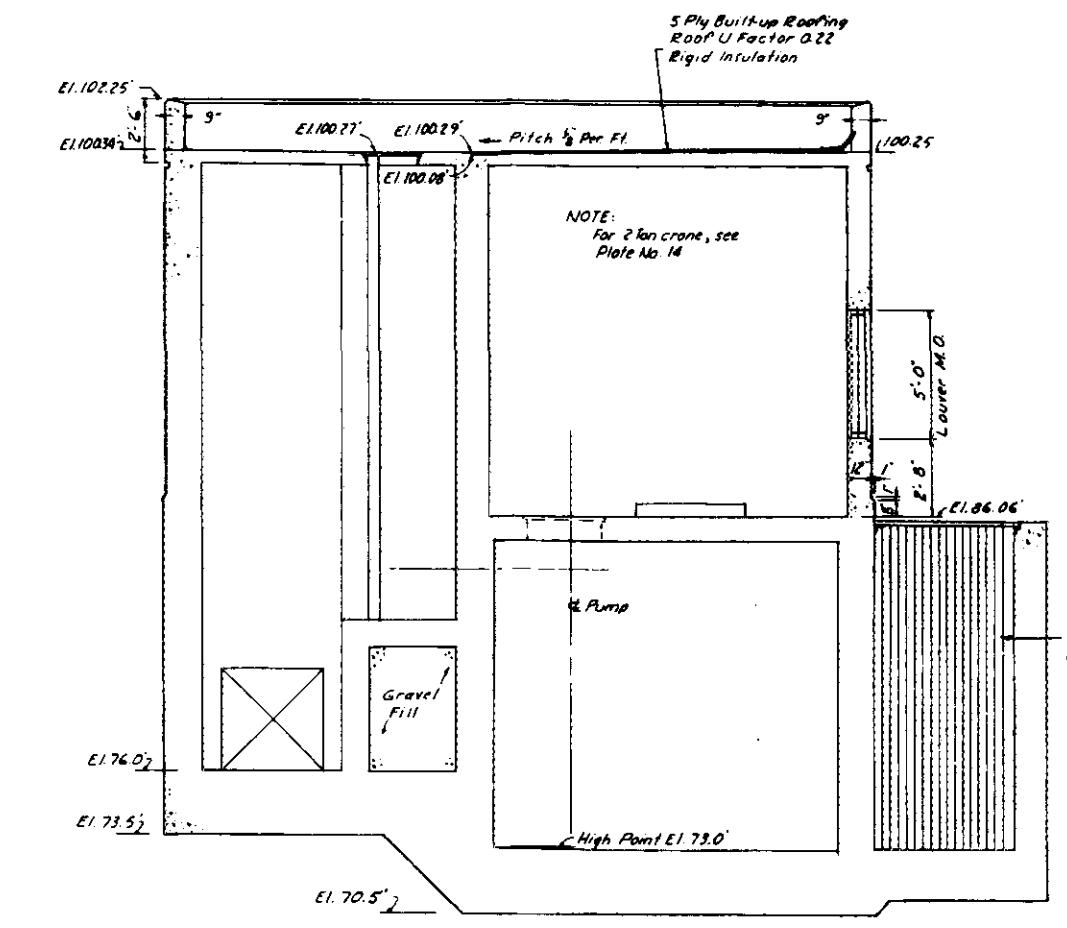
OWNER	NAME	DESIGNER
GREEN ENGINEERING AFFILIATES, INC.	BOSTON, MASS.	U.S. ARMY ENGINEER DIVISION, NEW ENGLAND COAST OF ENGINEERS BOSTON, MASS.
CHICOOPEE RIVER FLOOD CONTROL		
CHICOOPEE FALLS		
OAK STREET PUMPING STATION		
ARCHITECTURAL		
ELEVATIONS		
CHICOOPEE RIVER		MASSACHUSETTS
DATE		APRIL, 1963
DRAWN BY		GRAPHIC SCALE
REVIEWED BY		3/8" = 1'-0"
APPROVED BY		0' 0"
CHIEF ENGINEER		0' 6"
CONTRACT NUMBER		0' 12"
CT-5685		

PLATE NO. 11



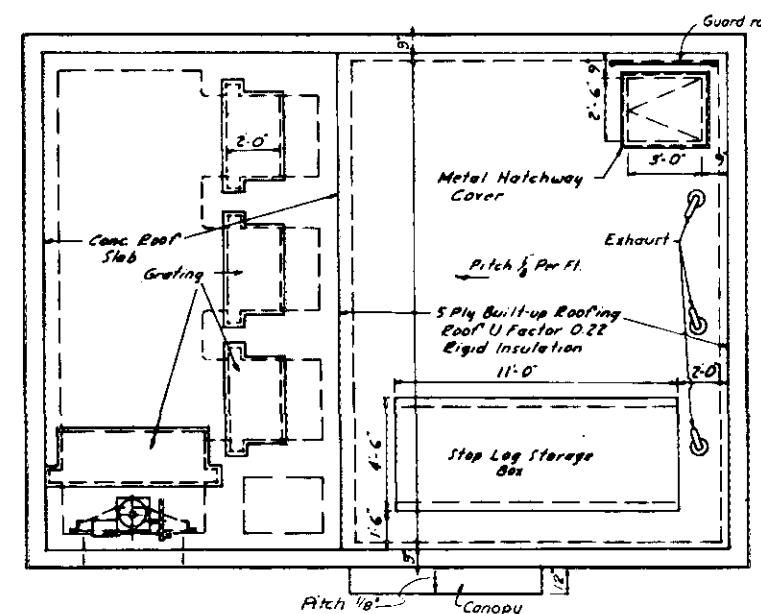
FLOOR PLAN

SCALE: $\frac{1}{8}$ " = 1'



SECTION A-A

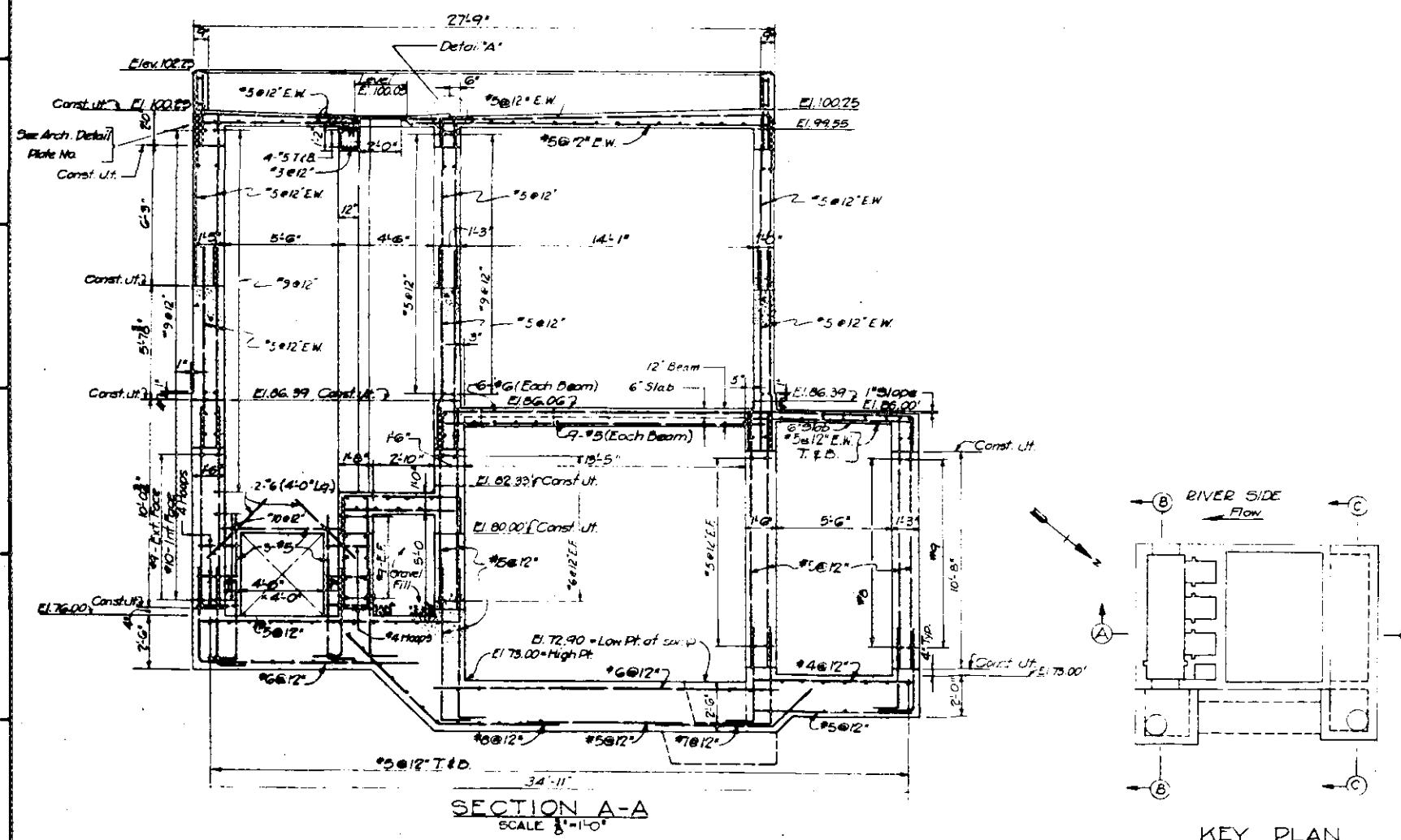
3645.70



ROOF PLAN

SCALLOP

PLATE NO. 12



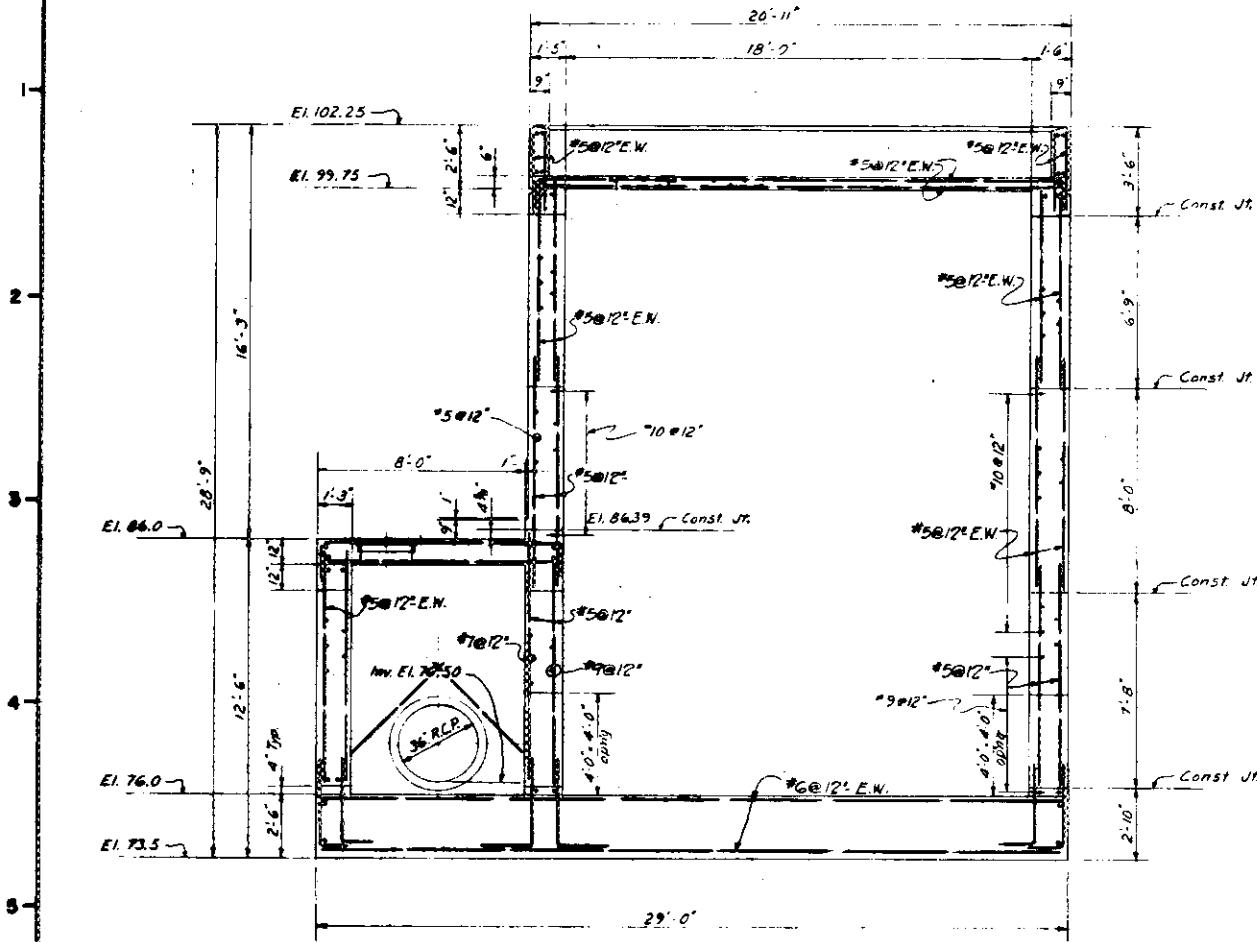
SECTION A-A

SCALE 1:100

KEY PLAN

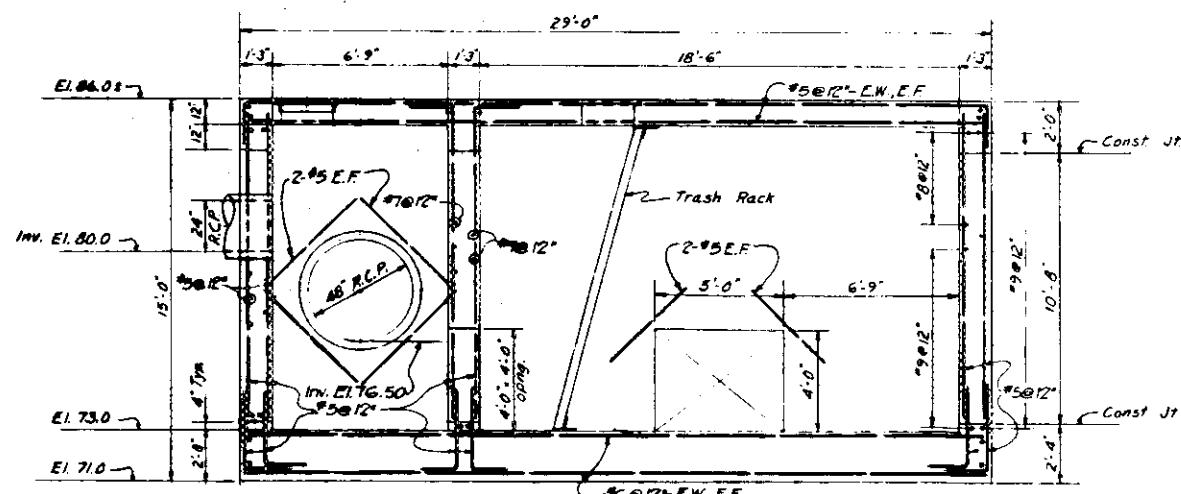
The graphic scale shows two horizontal distance markings. The first marking is labeled "3 1/8' = 1'-0"" and the second is labeled "4'". Both markings have a vertical dimension line extending downwards from the top of the scale.

WRIGHT - BOSTON		BOSTON	
GREEN ENGINEERING AFFILIATES, INC. BOSTON, MASS.			
ARCHITECT - ENGINEER			
U.S. ARMY ENGINEER DIVISION, NEW ENGLAND COMPT OF CONSTRUCTION GALVESTON, MASS.			
<p style="text-align: center;">CHICOOPEE RIVER FLOOD CONTROL CHICOOPEE FALLS OAK STREET PUMPING STATION STRUCTURAL REINFORCING DETAILS CHICOOPEE RIVER MASSACHUSETTS</p> <p style="text-align: right;">MTC APRIL 1963</p> <p style="text-align: center;">DETAILS AS SHOWN SPEC. NO. CIV-200-10-010-01-01 DRAWINGS NUMBER CT - 5855</p>			



SECTION B-B

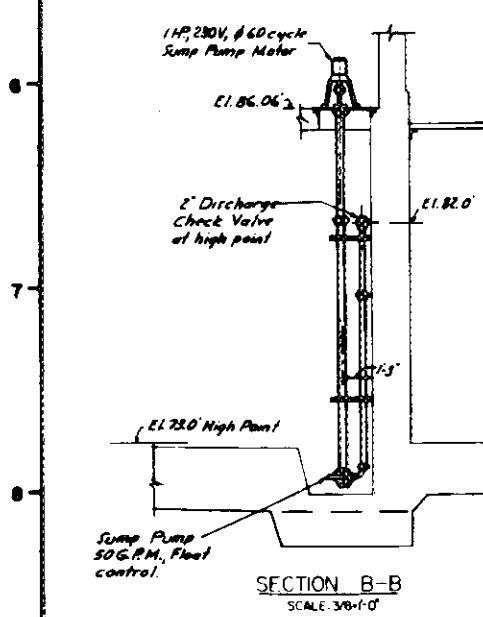
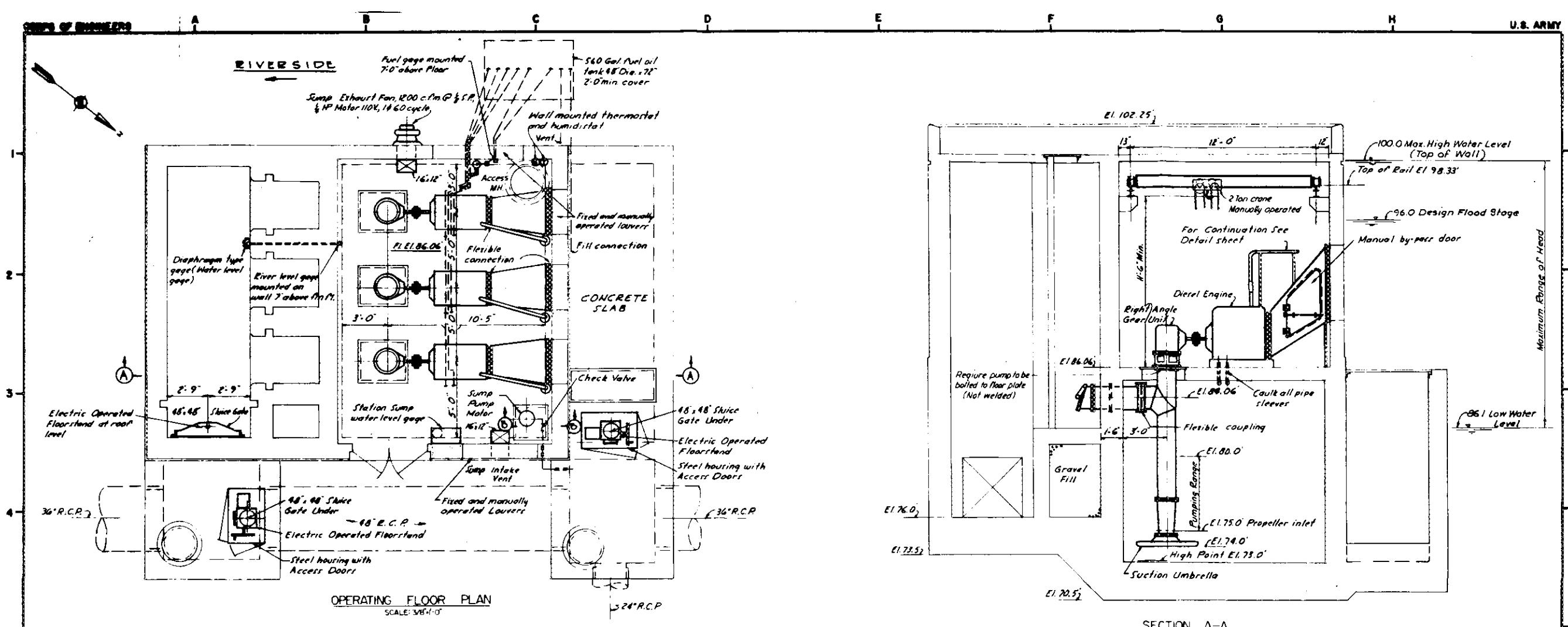
SCALE: $\frac{3}{8}$ " = 1'-0"



SECTION C-C

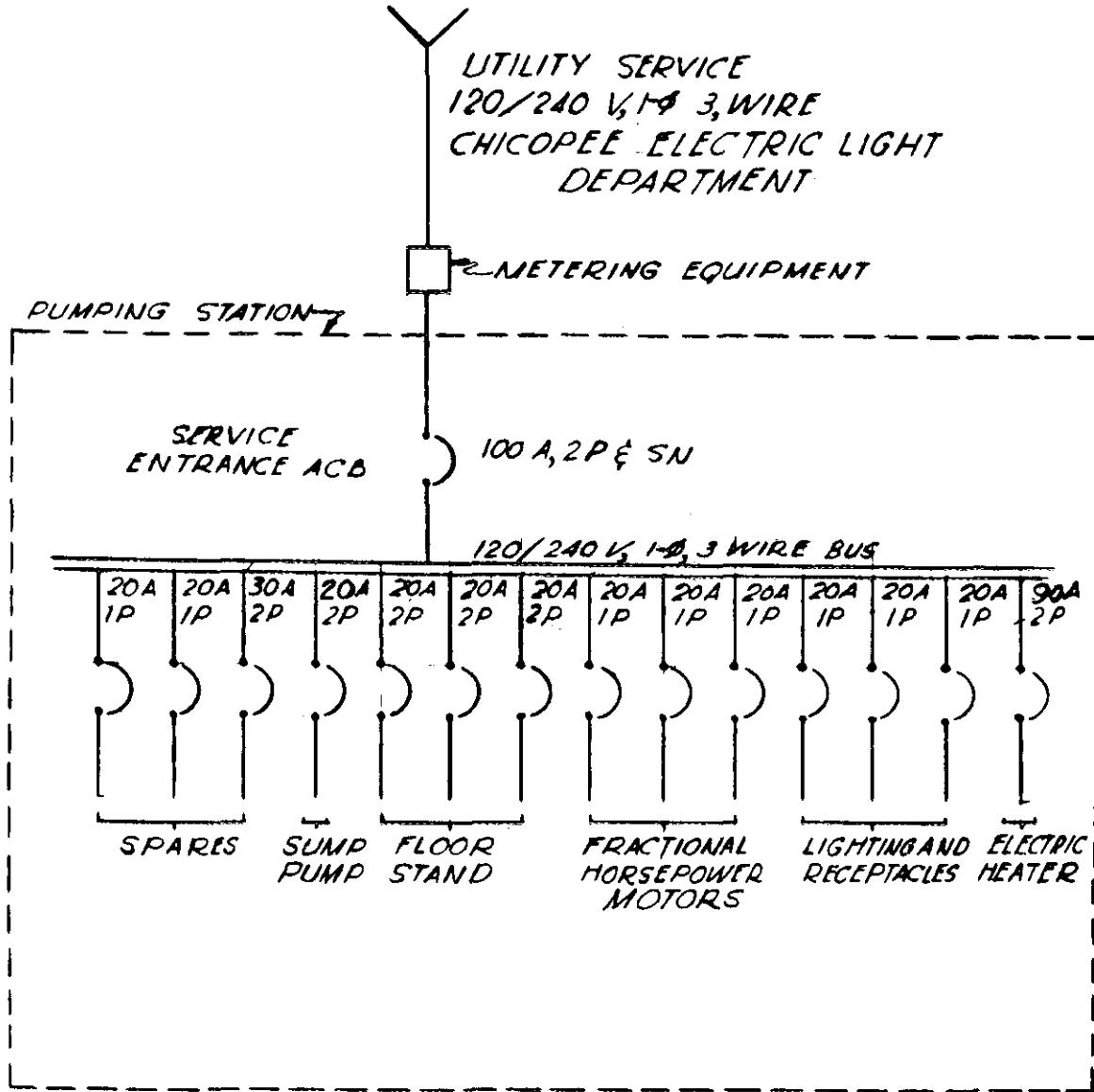
SCALE: $\frac{1}{4}$ in. = 1'-0"

STATION DATE		DESCRIPTION	
GREEN ENGINEERING AFFILIATES, INC. BOSTON, MASS. ANCHORIT-ENGINEER			
U.S. ARMY ENGINEER DIVISION, NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.			
NAME OR TITLE	NAME OR TITLE	CHICOOEE RIVER FLOOD CONTROL	
TELEGRAPHIC		CHICOOEE FALLS	
TELETYPE		OAK STREET PUMPING STATION	
TELEGRAPHIC		STRUCTURAL	
TELETYPE		REINFORCING DETAILS NO. 2	
TELEGRAPHIC		CHICOOEE RIVER MASSACHUSETTS	
TELETYPE		MAY APRIL, 1968	
MAILED AS INDICATED IN CIV. FORM 10-510-10-32			
MAILING NUMBER			
CT-5685			



NOTE:
For Isometric of Fuel Oil Piping, see
Main Street Pumping Station Plan

PLATE NO 15



OAK ST. PUMPING STATION

ELECTRICAL DISTRIBUTION

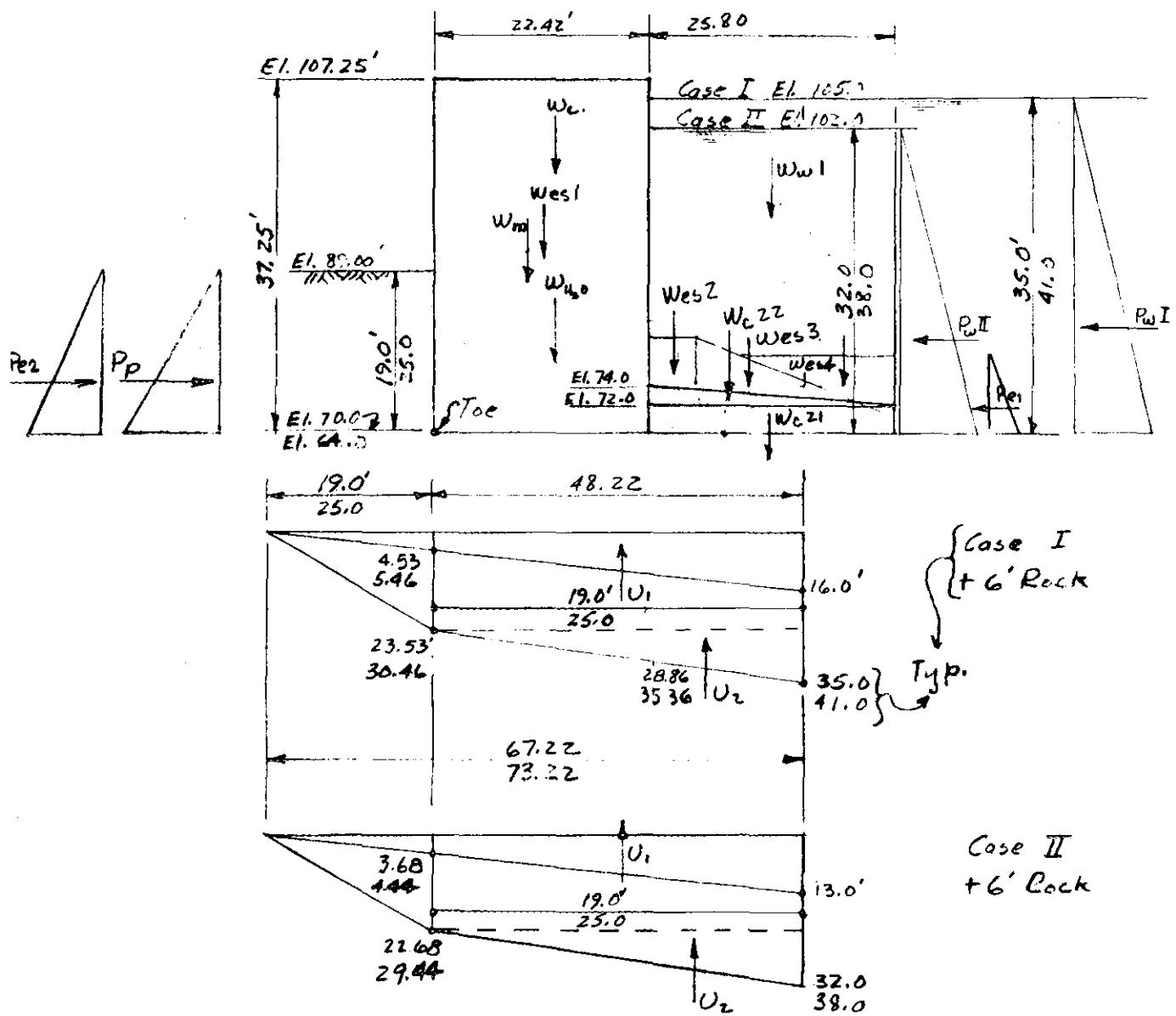
ONE-LINE DIAGRAM

PLATE NO. 16

GREEN ENGINEERING AFFILIATES, INC.
 ENGINEERS
 BOSTON, MASS.

PROJECT Chicopee Falls
 SUBJECT Main Street Pump Station

PROJECT NO. 6205
 SHEET NO. _____ OF _____
 DATE _____
 COMPUTED BY R.Palmer
 CHECKED BY S.D.P.



A-1

GREEN ENGINEERING AFFILIATES, INC.
ENGINEERS
BOSTON, MASS.

PROJECT Chicopee Falls

SUBJECT M. Street Pump Station

PROJECT NO. 6205

sheet no. 1 of _____

DATE Feb 5, 1963

COMPUTED BY L.H.

CHECKED BY DR

Center of Gravity of Conc. Struct. only. Moments about land
face of pump sta.

	Calculation (LxWxH)	Volume	↓	↑	Arm	↶	↷
Total	$22.42 \times 29.75 \times 37.25$	24850			11.21	278500	
①	$13.42 \times 14.00 \times 15.00$			2820	8.21		23100
②	$13.83 \times 15.00 \times 14.75$			3060	8.00		24500
③	$14.33 \times 15.00 \times 2.00$			430	8.25		3540
④	$6.00 \times 10.00 \times 9.00$			495	19.42		9610
⑤	$6.00 \times 10.00 \times 21.00$			1260	19.42		24500
⑥	$6.00 \times 5.00 \times 28.00$			840	19.42		16300
⑦	$6.00 \times 21.92 \times 2.25$			296	19.42		5750
⑧	$16.42 \times 3.00 \times 3.00$			148	8.21		1220
⑨	$14.92 \times 4.25 \times 26.00$			1650	7.46		12300
⑩	$14.92 \times 2.50 \times 33.25$			1240	7.46		9620
⑪	$6.00 \times 1.50 \times 33.25$			299	17.92		5370
⑫	$9.00 \times 4.50 \times 14.00$			568	5.75		3270
⑬	$11.50 \times 5.75 \times 18.00$			1190	5.75		6850
⑭	$9.42 \times 5.75 \times 33.25$			1800	16.21		29150
⑯	$1.00 \times 6.00 \times 5.00$			30	.50		15
⑰	$3.50 \times 2.00 \times 5.00$			35	4.60		161
⑱	$5.0 \times 1.00 \times 7.00$			35	11.75		410
⑲	$4.0 \times 1.50 \times 3.00$			18	8.25		149
		24850 16214		16214		278500 175815	
Wc		8636		11.86		102,685	

A-2

GREEN ENGINEERING AFFILIATES, INC.
 ENGINEERS
 BOSTON, MASS.

PROJECT Chicopee Falls

SUBJECT Main Street Pump Station

PROJECT NO. 6205
 SHEET NO. 2 OF 2
 DATE Feb 7, 1963
 COMPUTED BY D. R. L.
 CHECKED BY H.R.

Center of Gravity of Earth Fill only. Moments about land face of pump sta.

		Volume		Moment	
		↓	↑	Arm	↷
(9)	$14.92 \times 4.25 \times 7.75$	490		7.46	3660
(10)	$14.92 \times 2.50 \times 15.00$	561		7.46	4180
(11)	$6.00 \times 1.50 \times 15.00$	135		17.92	2420
(12)	$9.42 \times 5.75 \times 15.00$	812		16.21	13150
(5)	$6.0 \times 10.0 \times 8.0$	480		19.42	9320
		2478		13.20	32,730

Center of Gravity of Water to El. 105.00 Case I

		Volume		Moment	
		↓	↑	Arm	↷
(1)	$13.42 \times 14.00 \times 9.00$	1690		8.21	13870
(5)		1260			24500
(6)		840			16300
(8)		148			1220
(12)	$9.00 \times 4.50 \times 9.00$	365		5.75	2100
		4303		13.48	57,990

Center of Gravity of Water to El. 102.00 Case II

		Volume		Moment	
		↓	↑	Arm	↷
(1)		1690			13,870
(5)	$6.00 \times 10.00 \times 18.00$	1080		19.42	20,970
(6)	$6.00 \times 5.00 \times 25.00$	750		19.42	14,560
(8)		148			1220
(12)		365			2100
		4033		13.12	52,720

A-3

GREEN ENGINEERING AFFILIATES, INC.

ENGINEERS
BOSTON, MASS.PROJECT Chicopee FallsSUBJECT Main St. Pump Sta.

PROJECT NO. _____

SHEET NO. 3 OF _____

DATE _____

COMPUTED BY R.P.PCHECKED BY K.R.P

Center of Gravity of Misc. Equipment Items.

		Weight		Moment.	
		↓	↑	Arm	↷
Prime Mover	2×2.0^k	4.0		7.0	28
Crane	Unit	2.0 ⁺		15.12 ⁻	30
Stop Logs	.5x.5x5.0 x.055 ⁺ x 60EA	4.0		14.00	56
Sluice Gate	Unit	1.0		17.18	17
Sluice Gate	Unit	1.0		2.0'	2
Pump	2×3.0	6.0		11.92	71
Gear Unit	2×1.0	2.0		11.92	24
Pump Thrust	2×3.0	6.0		11.92	71
L.L. Floor	$14.08 \times 15.00 \times .100$	21.10		8.12	172
L.L. Roof	$14.33 \times 15.00 \times .050$	10.15		8.25	89
Wm		<u>57.85</u>		9.70 ⁻	560

A-4

GREEN ENGINEERING AFFILIATES, INC.
ENGINEERS
BOSTON, MASS.

PROJECT Chicopee Falls
SUBJECT Main Street Pump Sta.

PROJECT NO. _____
SHEET NO. 4 OF _____
DATE Feb 1
COMPUTED BY K. J. L.
CHECKED BY J. H.

Case I (wt per foot of LOADS)

		↓	↑	→	←	Arm	↷	↶
W_c	$8630 \times \frac{.150}{29.75}$	43.40				11.86	515	
West	$2478 \times \frac{.135}{29.75}$	11.23				13.20	148	
$W_{H,D}$	$4303 \times \frac{.0625}{29.75}$	9.04				13.48	122	
W_m	$\frac{57.85}{29.75}$	1.94				9.70	19	
U_{w1}	$25.80 \times 31.0 \times .0625$	50.00				35.32	1765	
W_{w2}	$2.00 \times 25.8 \times \frac{1}{2} \times .0625$	1.61				39.62	64	
W_{w3}	$5.0 \times 8.0 \times (.135 - .0625)$	2.90				24.92	71	
W_{m3}	$\frac{1}{2} \times 8.0 \times 20.8 \times .0725)$	6.00				34.35	206	
West	$\frac{1}{2} \times 12.5 \times 6.5 \times .0725)$	2.94				44.06	130	
W_{c1}	$25.80 \times 2.0 \times .150$	7.74				35.32	273	
W_{c22}	$\frac{1}{2} \times 25.8 \times 2.00 \times .150$	3.87				31.02	120	
U_1	$23.53 \times 48.22 \times .0625$		71.00			24.11		1710
U_2	$\frac{1}{2} \times 48.22 \times 11.47 \times .0625$		17.28			32.15		555
P_{c1}	$\frac{1}{2} \times 0.0725 \times 12^2 \times \frac{4}{3}$				1.7	4.00		7
P_{w1}	$\frac{1}{2} \times .0625 \times 35.0$				38.3	11.67		446
P_{c2}	$\frac{1}{2} \times 0.0725 \times 19^2 \times 0.50$				6.5	6.33		41
P_{w2}	$\frac{1}{2} \times 19.0 \times 23.53 \times .0625$				14.0	6.33		89
		130.67	88.28	20.5	400		3563	2718
			88.28					2718
			52.39					845
$\frac{\Sigma H}{\Sigma V} = \frac{19.5}{52.4} = 0.372$						$\bar{x} = 16.1$		
						$\bar{z} = 8.1$		MID $\frac{1}{3}$ BASE

$$f = \frac{52.39}{48.22} \left[1 \pm \frac{6 \times 8.1}{48.22} \right] = 1.09 [1 \pm 1.005]$$

$$= 2.18 \text{ KSF}, -0.00 \text{ KSF NET}$$

★ Note: Rock anchors will be provided,
similar to wall sects. adj. to
pump sta, to prevent differential movement
between the pumping station and adjacent walls

GREEN ENGINEERING AFFILIATES, INC.
ENGINEERS
BOSTON, MASS.

PROJECT Chicopee Falls
SUBJECT Main St. Pump St.

PROJECT NO. _____
SHEET NO. 5 OF _____
DATE _____
COMPUTED BY RDP
CHECKED BY DME

Case II

		↓	↑	→	←	Arm	↖	↗
W _c		43.40					515	
W _{es1}		11.23					148	
W _{H2O}	$40.33 \times \frac{.0625}{29.75}$	8.47				13.12	111	
W _m		1.94					19	
W _{w1}	$25.80 \times 28.0 \times .0625$	45.20				35.32	1593	
W _{w2}		1.61					64	
W _{es2}		2.90					71	
W _{es3}		6.00					206	
W _{es4}		2.94					130	
W _{c21}		7.74					273	
W _{c22}		3.27					120	
U ₁	$22.68 \times 48.22 \times .0625$		68.40			24.11		1648
U ₂	$\frac{1}{2} \times 48.22 \times 9.32 \times .0625$		14.03			32.15		452
Pw ₁	$\frac{1}{2} \times .0625 \times \frac{32.0}{2}$				32.0	10.67		341
Pw ₂	$\frac{1}{2} \times 19 \times 27.68 \times .0625$			13.45		6.33	- 85	
P _{e1}					1.7			
P _{e2}				6.5			41	
		<u>135.30</u>	<u>92.43</u>	<u>19.95</u>	<u>33.7</u>	<u>17.5</u>	<u>3376</u>	<u>2448</u>
		<u>$\frac{82.43}{52.87}$</u>				<u>6.6'</u>	<u>$\frac{2448}{928}$</u>	
RESULTANT IN 1/10 1/2 BASE					<u>$2 =$</u>			

$$P = \frac{52.87}{48.22} \left[1 \pm \frac{6 \times 6.6}{48.22} \right] = 1.10, (1 \pm 0.823) = 2.00 \text{ KSF}, +.19 \text{ KSF}$$

* See note case I

$$\frac{\Sigma H}{\Sigma V} = \frac{13.75}{52.87} = .260$$

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PROJECT Chicopee Falls
 SUBJECT Main St Pump Sta.

PROJECT NO. _____
 SHEET NO. 6 OF _____
 DATE _____
 COMPUTED BY EOP
 CHECKED BY EOP

Case II + 6' Rock (WALL ON BOTH SIDES WILL BE ANCHORED)

		↓	↑	→	←	Arm	↷	↶
Wc		43.40					515	
West		11.23					148	
Wh2o		8.47					111	
Wm		1.94					19	
Wwl		45.20					1593	
Ww2		1.61					64	
Wes2		2.90					71	
Was3		6.00					206	
Wes4		2.94					130	
Wc21		7.74					273	
Wc22		3.87					120	
Wrock	6.0 x 48.22 x .170	49.20				24.11	1185	
U1	29.44 x 48.22 x .0625		88.90			24.11		2140
U2	$\frac{1}{2} \times 8.56 \times 48.22 \times .0625$		12.90			32.15		415
Per1	$\frac{1}{2} \times .0725 \times 18^2 \times \frac{3}{4}$				3.9	6.00		24
PwII	$\frac{1}{2} \times .0625 \times 38.0$				45.1	12.67		571
Per2	$\frac{1}{2} \times .0725 \times 25 \times 0.5$				11.3	8.33		
Pp	$\frac{1}{2} \times 25.0 \times 29.44 \times .0625$				23.0	8.33	95	
		184.50	101.80		34.3	49.0		
		101.80					4722	
		82.70					3150	
						R = 19.0	1572	

$$\text{By Friction} = 49.0 - 11.3 - 23.0 = 14.7$$

$< 0.3 \times 82.70$ (taken by friction)

* See note Case I

$$\frac{\Sigma H}{\Sigma V} = \frac{14.7}{82.7} = 0.178$$

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PROJECT Chicopee Falls

SUBJECT Main St. Pump Sta.

PROJECT NO. _____
SHEET NO. 7 OF _____
DATE _____
COMPUTED BY H.P.
CHECKED BY RR

Case I + 6' Rock

		↓	↑	→	←	Arm	↷	↶
Wc		4340					515	
Wes1		11.23					148	
W _{H2O}		9.04					122	
Wm		1.94					19	
Ww1		50.00					1765	
Ww2		1.61					64	
Wes2		2.90					71	
Wes3		6.00					206	
Wes4		2.94					130	
W _{c21-22}	7.74 + 3.87 = 11.61	11.61					393	
W _{rock}		49.20					1185	
U ₁	30.46 × 48.22 × .0625		91.80			24.11		2215
U ₂	$\frac{1}{2} \times 10.54 \times 48.22 \times .0625$		15.90			32.15		511
P _{e1}				3.90		—		24
P _{w1}	$\frac{1}{2} \times .0625 \times 41.0$			52.50	13.67		95	718
P _{e2}				11.30		—		
P _p				23.80		8.33	198	
		189.87	107.70	35.10	56.40	17.6	4911	3468
		107.70		*	*		3468	
		82.17					1443	
							> 12.06	
							2 = 6.5	

$$\text{BY FRICTION} = 56.40 - 35.10 = 21.30 \text{ k}$$

$$< .4 \times 82.17 \text{ (by friction)}$$

$$.3 \times 153\% = .4$$

BOTTOM OF ROCK $P = \frac{82.17}{48.22} \left[1 \pm \frac{6.5 \times 6}{48.22} \right] = 1.705(1 \pm .810)$
 $= 3.08 \text{ ksf}, 0.32 \text{ ksf}$

* See note case I

A-8

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PROJECT CHICODEE FALLS

SUBJECT MAIN ST PUMP STATION

PROJECT NO. G205-2

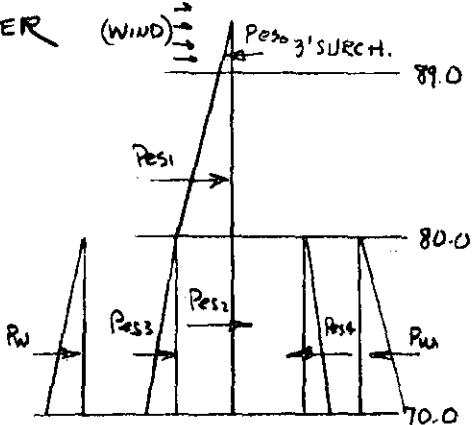
SHEET NO. 8 OF 1

DATE FEB 63

COMPUTED BY DR

CHECKED BY R.C.F.

Center of Gravity of structure with NORMAL WATER
WATER AT 80.0 ELEVATION
3 FT SURCHARGE
GROUND AT 89.0 EL.
WIND AT 50 #/FT²



LOADING #3

		\downarrow	\uparrow	\rightarrow	\leftarrow	ARM	$M \downarrow$	$M \uparrow$
W _{C-21,22}	(PAGE 4)	55.01				—	908	
West	\approx (PAGE 4) = 11.23 \pm	11.23					148	
W _{W1}	.0625 \times 6 \times 25.80	9.68				35.32	342	
W _{W2}		1.61				39.62	64	
W _{es2-3-4}		11.84					387	
P _{s1}	.130 \times $\frac{1}{3}$ \times 12 ² \times $\frac{1}{2}$		3.12			14.00	43.7	
P _{s2}	.130 \times $\frac{1}{3}$ \times 12 \times 10		5.20			5.00	26.0	
P _{s3}	.0725 \times $\frac{1}{3}$ \times 10 ² \times $\frac{1}{2}$		1.21			3.33	4.0	
WIND	.05 \times 18.25		0.91			28.12	25.6	
L	.0625 \times 10 \times 48.12					24.11		728
W _M	(PAGE 34)	1.94	30.20			970	19.0	
P _{s4}					1.72	4.00		8
		91.31	30.20	10.44	1.72		1967.3	
		$\frac{30.20}{30.20}$					$\frac{136.0}{136.0}$	736
		61.11						$\frac{1231.3}{1231.3}$

RESULTANT AT. $\frac{1231.3}{61.11} = 20.2 \text{ FT.}$

$\ell = 3.9'$

$$P = \frac{61.11}{48.22} \left[1 \pm \frac{6 \times 3.9}{48.22} \right] = 1.27 \text{ KSF } [1 \pm 0.486]$$

$$= 1.89, +.65 \text{ KSF NET } \\ .62, -.62 \text{ UPLIFT }$$

$$\underline{2.51 \text{ KSF } 1.27 \text{ KSF}}$$

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PROJECT CHICOPEE FALLS
SUBJECT MAINST. PUMPING STATION

PROJECT NO. 6205-2
SHEET NO. 9 OF 12
DATE FEB 63
COMPUTED BY DR
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Rock Anchors

{ REFER NOTE ON PAGE 4 }

LOADING #1
(REFER P4)

RESULTANT AT 16.1' FROM LAND FACE
 $E = 24.1L - 16.1 = 8.0 \text{ FT.}$

NOTE :

SHEAR WILL ALLOW 37.7K

AND THE COMPONENT IN TENSION ALLOWS 18.1K, SHEAR 37.7K.

SINCE THE BAR IS AT 30° WITH VERTICAL WE ASSUMED
THAT THE BAR WILL TEND TO BE PULLED IN TENSION RATHER
THAN BE SHEARED OFF. THIS IS A CONSERVATIVE ASSUMPTION

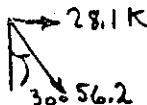
$$P = \frac{52.39}{48.22} \left[1 \pm \frac{6 \times 8.0}{48.22} \right] = 1.09 [1 \pm 1.005]$$

$$= \begin{array}{ll} 2.18 & 0.00 \text{ KSF NET} \\ 1.42 & 2.19 \text{ KSF UPLIFT} \\ \hline 3.65 & 2.19 \text{ KSF TOTAL} \end{array}$$

UNBALANCED HORIZONTAL : $40.0 - 20.5 - 0.2 \times 52.39 = 9.0 \text{ K} : \text{TRY 4 BARS (#11)}$

$$\text{Tension } A_s f_s = 1.56 \times 36.0 = 56.2 \text{ K}$$

$$\text{Shear } A_s f_s = 1.56 \times 18.2 \times 1.33 = 37.7 \text{ K}$$



LOADING #2

(REFER P5)

RESULTANT AT 17.5' FROM LAND FACE

$$E = 24.1L - 17.5 = 6.6 \text{ FT.}$$

$$P = \frac{52.87}{48.22} \left[1 \pm \frac{6 \times 6.6}{48.22} \right] = 1.10 [1 \pm 0.823]$$

$$= \begin{array}{ll} 2.00 & +.19 \text{ KSF NET} \\ 1.42 & 2.00 \text{ KSF UPLIFT} \\ \hline 3.42 \text{ KSF} & 2.19 \text{ KSF} \end{array}$$

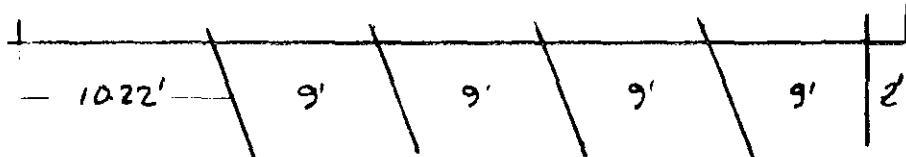
UNBALANCED HORIZONTAL :

$$T = A_s f_s = 1.56 \times 27.000 = 42.1 \text{ K}$$

(#21) $\frac{1}{2} \times 21.05 \text{ K} < \text{component}$

$$\frac{4 \times 21.05}{3.2} = 26.3 \text{ K}$$

LAND



LOAD 1 GOVERNS

9' SPACING

(9x9' type)

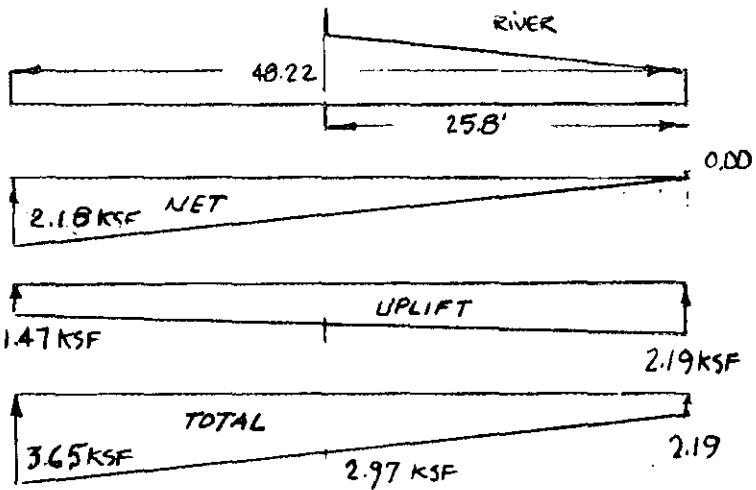
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PROJECT CHICOREE FALLS
 SUBJECT MAIN ST PUMPING STATION

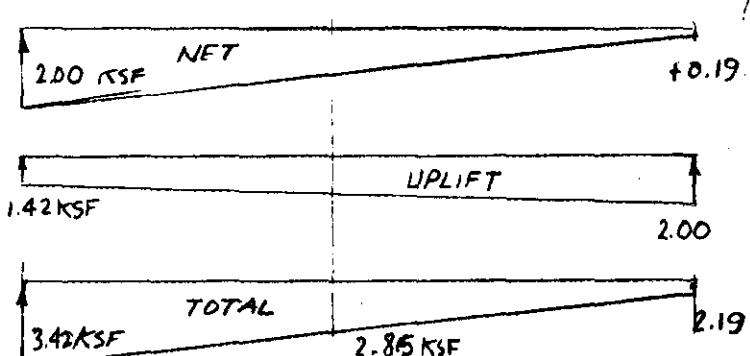
PROJECT NO. 6205-2
 SHEET NO. 10 of _____
 DATE FEB 63
 COMPUTED BY WR
 CHECKED BY RCF

PRESURES (AT BOTTOM OF CONCRETE)

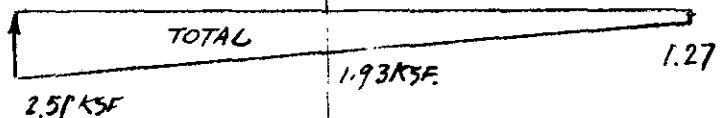
LOADING #1 (P-49)



LOADING #2 (P5.9)



LOADING #3 (P.8)



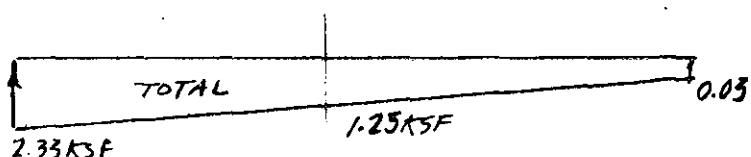
CONSTRUCTION (P.4)

$$W_c = 55.01 \quad 908 \text{ ft}$$

$$W_m = 1.94 \quad 19 \text{ ft}$$

$$\frac{927}{56.95} = 16.3 \quad l = 7.8'$$

$$P = \frac{56.95}{48.22} \left[1 \pm \frac{6 \times 7.8}{48.22} \right] = 1.18 (1 \pm .972)$$



A-11

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PROJECT NO. 6205-2

SHEET NO. 11 OF 1

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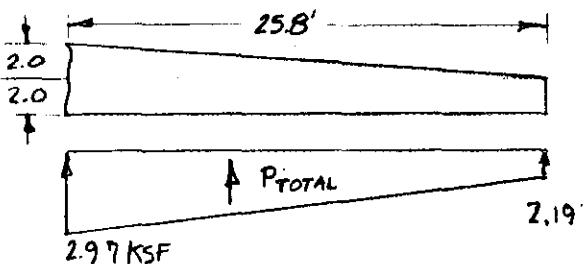
COMPUTED BY DR

CHECKED BY RGP

PROJECT CHICOPEE FALLS
SUBJECT MAIN ST. PUMPING STATION

HEEL APRON

LOADING #1 (P.4)



SHEAR

MOMENT

$W_{w1} = 50.00$	$\times 12.90 = 645.0 \downarrow$
$W_{es2} = 2.90$	$\times 2.50 = 7.2 \downarrow$
$W_{es3} = 6.00$	$\times 11.93 = 71.6 \downarrow$
$W_{es4} = 2.94$	$\times 21.63 = 63.6 \downarrow$
$W_{e21} = 7.74$	$\times 12.90 = 100.0 \downarrow$
$W_{e22} = 3.87$	$\times 8.60 = 33.3 \downarrow$
$W_{lw2} = \frac{1.61}{15.06}$	$\times 17.20 = 27.7 \downarrow$
2.19×25.80	$= P_{T1} = 56.60 \uparrow$
$0.78 \times 25.80 \times .5$	$= P_{T2} = 10.00 \uparrow$

8.40

131.8

LOADING #2 (P.5)

<u>SHEAR</u>	<u>MOMENT</u>
$W_{w1} = 45.20$	$\times 12.90 = 583.0 \downarrow$
$W_{es2} \rightarrow W_{lw2} \text{ etc } = 25.06 \downarrow$	$= 303.4 \downarrow$
2.19×25.8	$= P_{T1} = 56.60 \uparrow$
$0.66 \times 25.8 \times .5$	$= P_{T2} = 8.52 \uparrow$

5.14

83.1

LOADING #1. (GOVERNS BY INSPECTION) $d = 48 - 4 = 44'' \uparrow$

$$A_s = \frac{131,800}{.907 \times 27,000 \times 44} = .1213 \text{ in}^2/\text{in}$$

#11 @ 12" used

AT P.S. : USE: "8-6" C-C $\cdot (.131 \text{ in}^2/\text{in})$ (TOP)

$1.57 \text{ in}^2/\text{ft}$ (TOP)

AT MIO HEEL: USE: "8-12" C-C

A-12

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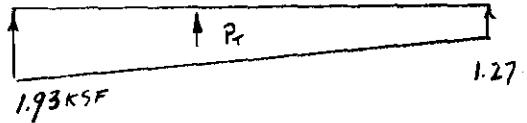
PROJECT CHICOPEE FALLS
SUBJECT MAIN ST PUMPING STATION

PROJECT NO. 6205-2
SHEET NO. 12 OF 12
DATE FEB 63
COMPUTED BY DR
CHECKED BY JL

HEEL APRON

→ 25.8'

LOADING #3 (P8, II)



SHEAR

$$W_{w1} = 9.68 \downarrow \\ W_{c21} \rightarrow W_{es2} \rightarrow W_{w2} = 25.06 \downarrow$$

$$1.27 \times 25.8 = P_1 = 32.75 \uparrow \\ 0.66 \times 25.8 \times .5 = P_2 = 8.52 \uparrow$$

MOMENT

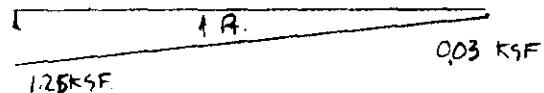
$$x 12.90 = 124.8 \downarrow \\ x - = 303.4 \downarrow$$

$$x 12.90 = 422.5 \uparrow \\ x 8.60 = 733 \uparrow$$

6.53 ↑

67.1 ↗

CONSTRUCTION:



SHEAR

$$W_{c21-22} = 11.61 \downarrow \\ 0.03 \times 25.8 = P_1 = 0.78 \uparrow \\ 1.22 \times 25.8 \times .5 = P_2 = 15.73 \uparrow$$

MOMENT

$$— = 133.3 \downarrow \\ x 12.90 = 10.0 \uparrow \\ x 8.60 = 135.0 \uparrow$$

4.90 ↑

11.7 ↗

LOADING #3

$$A_s = \frac{67.1}{1.44 \times 43} = 1.08 \text{ in}^2/\text{ft}$$

AT P.S. : USE # 9-12" C-C $A_s = 1.00$ (BOTTOM)

AT MID HEEL : USE # 9-24" C-C (BOTTOM)

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PROJECT CHICOPEE FALLS
SUBJECT MAIN ST PUMPING STATION

PROJECT NO. 6205-2
SHEET NO. 13 OF 1
DATE FEB 63
COMPUTED BY G.R.
CHECKED BY H.C.P.

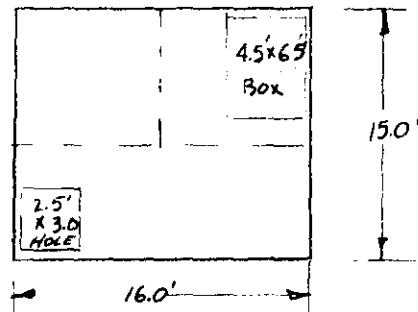
ROOF SLAB: E-W: $14\text{-}1" + \frac{1}{2}[12+15"] = 15.2 \text{ FT}^{\pm}$ (BELOW PARAPET)
N-S: $17\text{-}0" - \frac{1}{2}[12+12"] = 16.0 \text{ FT}^{\pm}$

USING 15'x16' FOR DESIGN

$$\frac{l_1}{l_2} = \frac{15}{16} = .94$$

CASE 4 - ACI $m = .94$

C. NEGATIVE MOMENT	= 0.063	- 0.058
D. NEGATIVE MOMENT	= 0.031	- 0.029
POSITIVE MOMENT	= 0.048	- 0.044



$$\begin{aligned}
W_{\text{CONC}} &= 6/12 \times .150 & = .075 \text{ KSF} \\
W_{\text{LL}} &= & = .080 \text{ KSF} \\
W_{\text{ROOFING}} &= & = .010 \text{ KSF} \\
W_{\text{WOOD}} &= & = .062 \text{ KSF} \\
&& \hline
&& .227 \text{ KSF}
\end{aligned}$$

$$\begin{aligned}
&= \underline{\text{WOOD WT.}} \\
60 \text{ pieces} @ 50 \text{ ft}^3 / \text{ft}^3 & \quad \frac{1}{2} \times \frac{1}{2} \times 5' \\
\text{Volume} &= 60 \times 1.25 \text{ ft}^3 = 7.5 \text{ ft}^3 \\
.05 \times 7.5 &= 3.75 \text{ K}^{\pm}
\end{aligned}$$

SHORT SPAN:

$$-M = .063 \times .227 \times 15^2 \times 12 = 38.5 \text{ in-K/FT.}$$

$$d^2 = \frac{38,500}{160 \times 12} \therefore d = 4.50" \quad \text{USE } d = 5.0$$

$$A_s = \frac{38,500}{20,000 \times .885 \times 5.0} = 0.44 \text{ in}^2/\text{FT} \quad \text{USE: #4-5\frac{1}{2}" C-C} \quad (\text{short span})$$

$\pm 1\frac{1}{2}$

LONG SPAN:

$$-M = \frac{.058}{.063} (38.5) = 35.5 \text{ in-K/FT}$$

$$d^2 = \frac{35,500}{160 \times 12} \therefore d = 4.30" \quad \therefore 4.3 + \#4BAR = 4.8"$$

$$A_s = \frac{35,500}{20,000 \times .885 \times 4.5} = 0.44 \text{ in}^2/\text{FT.} \quad \therefore \text{USE } d = 5.0" \text{ in SHORT SPAN}$$

$\text{USE } d = 4.5" \text{ in LONG SPAN}$

USE #4-5\frac{1}{2}" C-C (LONG SPAN)

$\pm 1\frac{1}{2}$

A-14

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PROJECT

CHICOOEE FALLS

SUBJECT MAIN ST. PUMPING STATION

PROJECT NO. 6205-2
 SHEET NO. 14 OF 14
 DATE FEB 63
 COMPUTED BY DR
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ROOF SLAB: (Continued)

SHORT SPAN:

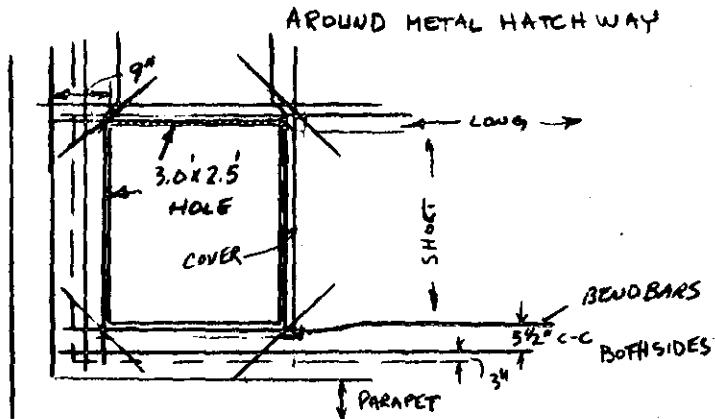
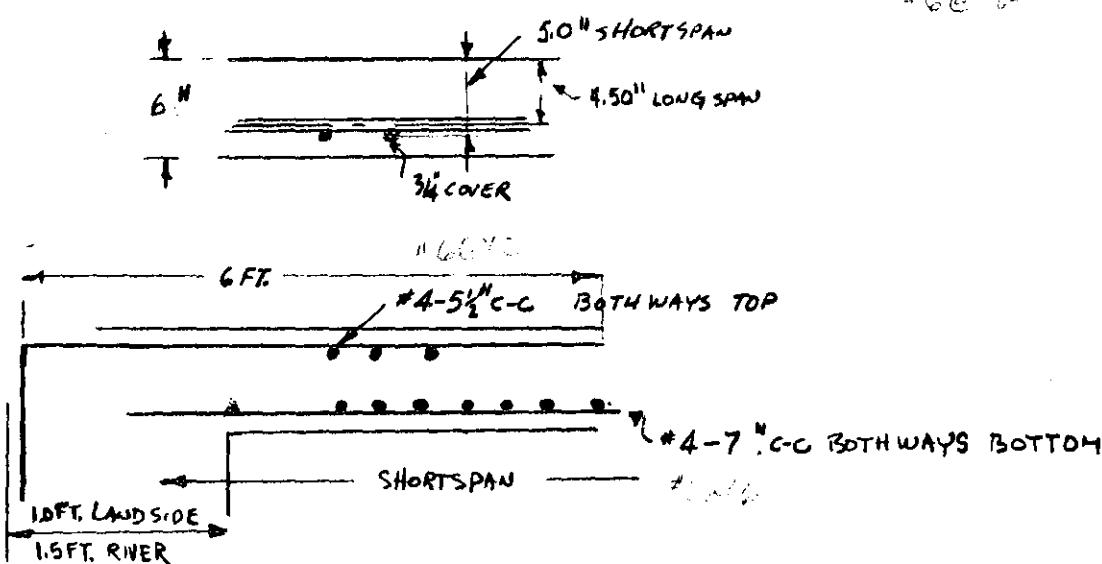
$$+M = .048 \times .227 \times 15^2 \times 12 = 29.4 \text{ mK/FT} \quad d = 4.25 - *4 = 3.75"$$

$$A_s = \frac{29,400}{.885 \times 20,000 \times 5.00} = .334 \text{ m}^2/\text{FT} \quad \text{USE } *4-7"\text{C-C}$$

LONG SPAN

$$+M = \frac{.044}{.048} (29.4) = 27.0 \text{ mK/FT}$$

$$A_s = \frac{27,000}{.885 \times 20,000 \times 4.50} = .340 \text{ m}^2/\text{FT} \quad \text{USE } *4-7"\text{C-C}$$

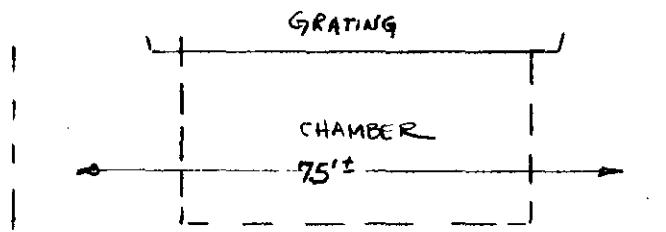


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PROJECT CHICORPE FALLS
SUBJECT MAINST PUMPING STATION

PROJECT NO. 6205-2
SHEET NO. 15 OF 1
DATE FEB 63
COMPUTED BY GR
CHECKED BY PT

TOPSLAB - OVER 2 CHAMBERS (north side)



USING 6" SLAB

$$+M = \frac{1}{14} w l^2$$

$$-M = \frac{1}{9} w l^2$$

$$\begin{aligned} \text{FROM P13 } W &= .227 \text{ KSF} \\ \text{Less } \frac{1}{2} \text{ WOOD } &= .031 \text{ KSF} \\ &\underline{.196 \text{ KSF}} \end{aligned}$$

$$WT/FT = .196 \text{ K/FT}^2$$

$$+M = \frac{1}{14}(196)(7.5)^2 = .787 \text{ K/FT}$$

$$A_s = \frac{787 \times 12}{(20000)(885)5} = .107 \text{ m}^2/\text{FT}$$

#4-12" C-C

$$-M = \frac{1}{9}(196)(7.5)^2 = 1.23 \text{ K}$$

$$A_s = \frac{1230 \times 12}{(20000)(885)5} = .167 \text{ m}^2/3\text{FT}$$

H4-12" C-C

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PROJECT CHICOPEE FALLS

SUBJECT MAIN ST PUMPING STATION

PROJECT NO. 6705-2
SHEET NO. 17 OF 1
DATE FEB 63
COMPUTED BY GR
CHECKED BY JL

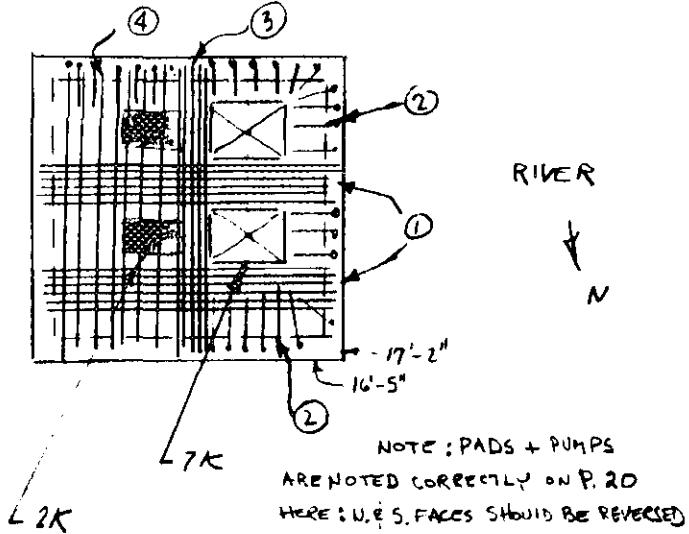
OPERATING FLOOR SLAB:

PUMP ENGINE : 2K
GEAR UNIT : 1K
PUMP : 3K > 7K
THRUST : 3K

$$D.L = .150 \times \frac{12}{12} = .150 \text{ KSF}$$

$$L.L = \underline{\quad} = .100 \text{ KSF}$$

$$D.L + L.L = \underline{\quad} = .250 \text{ KSF}$$

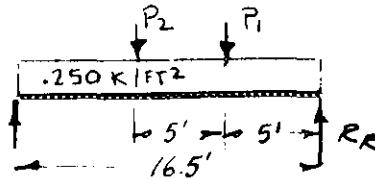


- ① MAIN BAND OF STEEL THROUGH OPENINGS AND ON THE SIDE WHERE THE CANTILEVER WOULD BE TOO GREAT TO ASSUME CANTILEVER DESIGN OF THE STEEL

LENGTH SAY = 16.5 FEET
WIDTH = 3.5 FEET

$$P_1 = \frac{1}{2}(7+7) = 7K$$

$$P_2 = \frac{1}{2}(2+2) = 2K$$



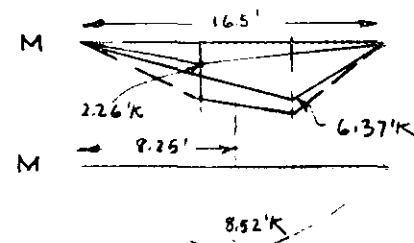
$$\text{FOR 1FT SECTION: } wL^2/8 = .25 \times 16.5^2 \times \frac{1}{8} = 8.52 \text{ K @ } \frac{1}{4}$$

$$M \text{ under } P_1: M = \frac{10.5}{16.5} (7)(5) \frac{1}{3.5} = 6.37 \text{ K}$$

$$M \text{ under } P_2: M = \frac{6.5}{16.5} (2)(10) \frac{1}{3.5} = 2.26 \text{ K}$$

MAX MOMENT BETWEEN 5' & 8.25' LT RT SUPPORT.

SAY 7' FROM RT SUPPORT.:



$$M_{\text{MAX}} = .250 \frac{7}{2} (16.5 - 7) + \left[7 \frac{(5)9.5}{16.5} + 2 \frac{(6.5)(7)}{16.5} \right] \frac{1}{3.5}$$

$$M_{\text{MAX}} = 8.25 + 5.75 + 1.57 = 15.6 \text{ K}$$

$$d^2 = \frac{15,600 \times 12}{160 \times 12} = 9.8'' \quad \underline{\text{USE 12" SLAB}}$$

$$d = 12'' - \frac{3}{4}'' - \frac{1}{2}'' = 10.8''$$

$$A_s = \frac{15,600}{20,000 \times .885 \times 10.8} = .082 \text{ in}^2/\text{in}$$

BOTTOM: USE #7-7"CC = (.086 in²/in)

A-17

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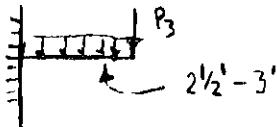
PROJECT CHICOPEE FALLS

SUBJECT MAIN ST PUMPING STATION

PROJECT NO. 6205-2
SHEET NO. 18 OF _____
DATE FEB 63
COMPUTED BY DRP
CHECKED BY DRP

OPERATING SLAB FLOOR (CONTINUED) (REFER PREVIOUS PAGE)

(2) CANTILEVER:



$$L.L. + D.L. = .250 \text{ KSF}$$

$$7K \div 2[4+3] = .50 \text{ K/FT ALONG EDGES OF A } 4 \times 3 \text{ HOLE} = P_3$$

FOR 1 FT SECTION:

$$\begin{aligned} M &= .50 \times 3 &= 1.5 \text{ 'K} \\ M &= .250 \times 3 \times 1.5 &= 1.125 \text{ 'K} \\ && \hline & & 2.7 \text{ 'K} \end{aligned}$$

$$A_s = \frac{2,700}{20,000 \times .885 \times 10.5} = .0146 \text{ in}^2/\text{in}$$

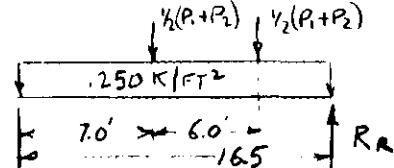
USE # 5-12" C-C (TOP) (SEE NEXT PAGE)

(3) MAIN BAND OF STEEL FOR SAY 4 FT. AS IN (1)

$$\text{LENGTH SAY} = 16.5 \text{ FT.}$$

$$\text{WIDTH SAY} = 4.0 \text{ FT.}$$

REFER PREVIOUS PAGE

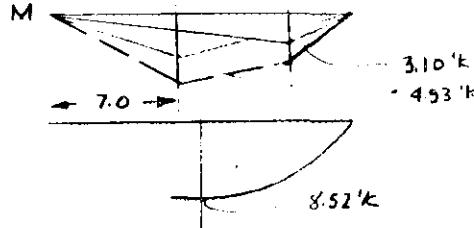


$$\frac{1}{2}(P_1+P_2) = \frac{1}{2}(7+2) = 4.5 \text{ K}$$

$$\text{ONE FT. SECTION } w l^2 / 8 = .25 \times 16.5^2 \times \frac{1}{8} = 8.51 \text{ 'K} @ 4$$

$$M \text{ UNDER LOADS: } M = \frac{1}{16.5} (4.5)(3.5) \frac{1}{4.0} = 3.10 \text{ 'K}$$

$$M = \frac{1}{16.5} (4.5)(9.5) \frac{1}{4.0} = 4.53 \text{ 'K}$$



MAX MOMENT AT 7' ± FROM LEFT END

$$M_{MAX} = 8.5 + 4.53 + \frac{7}{13}(3.10)$$

$$M_{MAX} = 8.5 + 4.53 + 1.67 = 14.7 \text{ 'K}$$

$$d = 10.8'' - 0.9'' = 9.9''$$

$$A_s = \frac{14,700}{20,000 \times .885 \times 9.9} = .084 \text{ in}^2/\text{in}$$

BOTTOM USE # 7-7" C-C (0.86 in²/in)

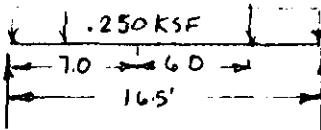
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PROJECT CHICOPEE FALLS
 SUBJECT MAIN ST PUMPING STATION

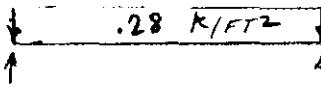
PROJECT NO. 6205-2
 SHEET NO. 19 OF 1
 DATE FEB 63
 COMPUTED BY WR
 CHECKED BY PIP

OPERATING FLOOR SLAB (cont.)

④ Length SAY 16.5 FT
 WIDTH SAY 6 FT



P_2 taken care of previously but
 ADD $\frac{1}{2}P_2$ to ENTIRE FLOOR REMAINING
 $2K \div 5' \times 15' = .03 \text{ KSF}^+$



$$+ M = \frac{1}{8} w l^2 = \frac{1}{8} \times .280 \times 16.5^2 = 54 \text{ 'K}$$

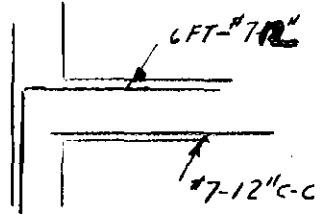
$$- M = \frac{1}{9} w l^2 = \frac{1}{9} \times .280 \times 16.5^2 = 8.5 \text{ 'K}$$

$$+ A_s = \frac{5400}{20,000 \times .885 \times 9.9} = .031 \text{ in}^2/\text{in}$$

USE #7-12" C-C BOTTOM (.05 in²/in)

$$- A_s = \frac{8,500}{20,000 \times .885 \times 9.9} = .049 \text{ in}^2/\text{in}$$

USE #7-12" C-C (TOP)



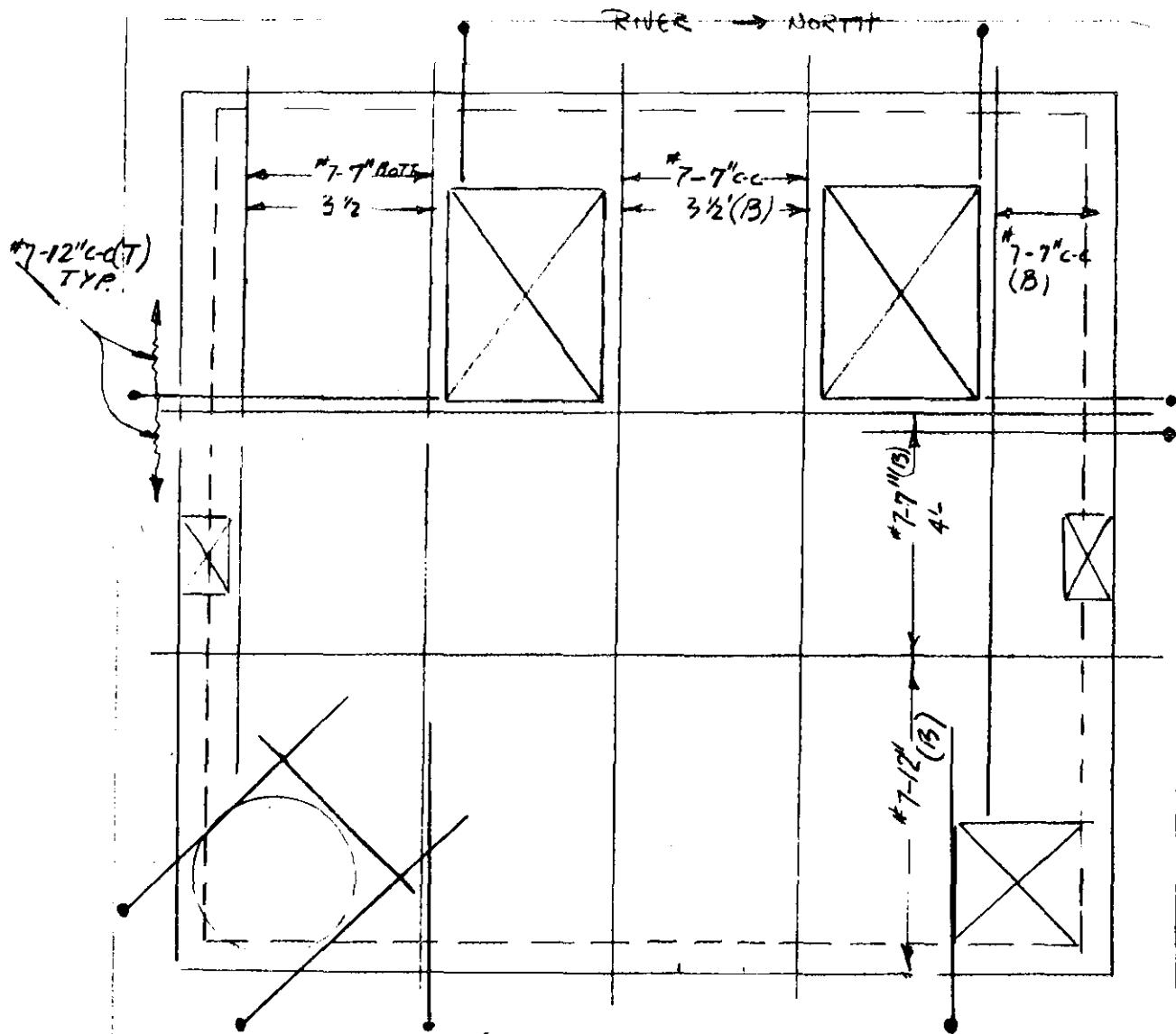
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PROJECT CHICOPEE FALLS

SUBJECT MAIN ST PUMPING STATION

PROJECT NO. 6205-2
 SHEET NO. 20 OF 20
 DATE FEB 63
 COMPUTED BY DR
 CHECKED BY D.L.D.

OPERATING ROOM SLAB $\frac{3}{8}'' = 1'$



(T) #5-12" SHRINKAGE

A-20

PROJECT Chicopee Falls

SUBJECT Main St. Pump Station

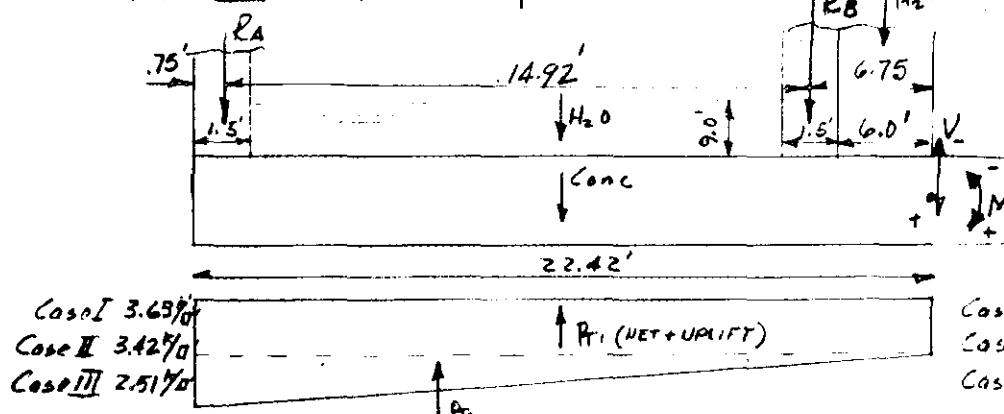
Base Slab Design

Shears & Moments at Riverside of Wall from Heel design

$$\text{Case I } V = 8.40 \text{ k} \downarrow M = +131.8 \text{ k}$$

$$\text{Case II } V = 5.14 \text{ k} \downarrow M = +83.1 \text{ k}$$

$$\text{Case III } V = 6.53 \text{ k} \uparrow M = -67.1 \text{ k}$$



$$\begin{aligned} \text{Case I } & 2.97 \text{ k/in} \\ \text{Case II } & 2.85 \text{ k/in} \\ \text{Case III } & 1.93 \text{ k/in} \end{aligned}$$

Case I

$$EMR_A \text{ out } H_2O = .0625 \times 31.0 \times 6.0 + 11.63 \times 18.67 = +217.0$$

$$\text{in } H_2O = .0625 \times 13.42 \times 3.00 = +7.55 \times 7.46 = +56.3$$

$$\text{Case } = .150 \times 22.42 \times 4.00 = +13.45 \times 10.46 = +140.8$$

$$P_{T1} = 2.97 \times 22.42 = -66.70 \times 10.46 = -695.0$$

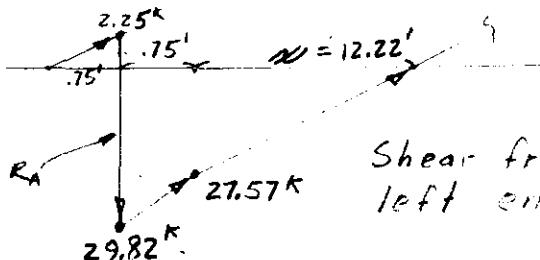
$$P_{T2} = \frac{1}{2} \times .68 \times 22.42 = -7.63 \times 6.72 = -51.3$$

$$V = +8.40 \times 21.67 = +182.0$$

$$M = -33.30 \text{ k} - 18.4 \text{ k} = +131.8$$

$$R_B = \frac{18.4}{14.92} = +1.23 \text{ k} \quad R_A = -33.30 + 1.23 = 0 \quad R_A = +32.07$$

$$V_u = (3.65 - .60) x - .033 \frac{x^2}{2} = 3.05x - .0165x^2$$



$$V = 0 = .0165x^2 - (3.05 - .56)x + 27.57 \quad .0165x^2 - 2.49x + 27.57$$

$$x = \frac{2.49 - \sqrt{6.20 - 4 \times .0165 \times 27.57}}{.033} = 12.22'$$

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PROJECT Chicopee Falls
SUBJECT Main St. Pump Station

PROJECT NO. 6205
SHEET NO. OF
DATE 3/4/63
COMPUTED BY R.P. Holmes
CHECKED BY RPK

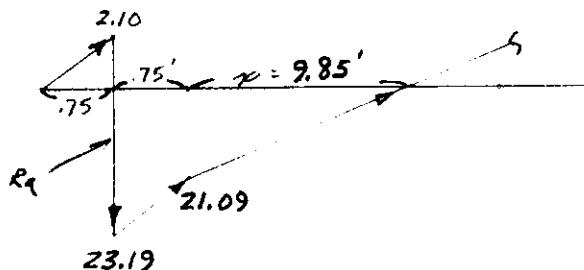
$$\begin{aligned}
\Sigma M \times R_A & 32.07 \times 12.97 = -416.0 \uparrow \\
\text{Conc} & .60 \times \frac{13.72^2}{2} = -56.5 \uparrow \\
P_{T_1} & 3.65 \times \frac{13.72^2}{2} = +343.0 \uparrow \\
P_{T_2} & .0165 \times \frac{13.72^3}{3} = -14.2 \uparrow \\
H_2O & .0625 \times 9.0 \times \frac{12.22^2}{2} = -\frac{41.9}{-185.6} \uparrow \\
A_s & = \frac{185.6}{2.00 \times 44} = 2.11 \square'' \quad \text{Top } \underline{\#11 @ 9''} \quad A_s = 2.08
\end{aligned}$$

Case II

$$\begin{aligned}
\text{outlet } H_2O & = .0625 \times 28.0 \times 6.0 = +10.50 \times 18.67 = +196.0 \\
\text{middle } H_2O & = +7.55 + 56.3 \\
\text{Conc} & = +13.45 + 140.8 \\
P_{T_1} & = 2.85 \times 22.42 = -63.80 \times 10.46 = -668.0 \\
P_{T_2} & = \frac{1}{2} \times .57 \times 22.42 = -6.38 \times 6.72 = -42.8 \\
V & = +5.14 \times 21.67 = +111.5 \\
M & = \frac{+83.1}{-33.54} - 123.1 \uparrow
\end{aligned}$$

$$R_B = \frac{123.1}{14.92} = 8.25^k \quad R_A = 33.54 - 8.25 = 25.29^k$$

$$V_o = (3.42 - .60)x - .0254 \frac{x^2}{2} : 2.82x - .0127x^2$$



$$V_o = 21.09 - (2.90 - .56)x + .0127x^2 = .0127x^2 - 2.26x + 21.09 = 0$$

$$x = \frac{2.26 - \sqrt{5.10 - (4 \times .0127 \times 21.09)}}{.0254} = 9.85'$$

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PROJECT Chicago Falls

SUBJECT Maui St. Pump Sta.

PROJECT NO. _____
 SHEET NO. _____ OF _____
 DATE 3/11/17
 COMPUTED BY J.R.
 CHECKED BY J.R.

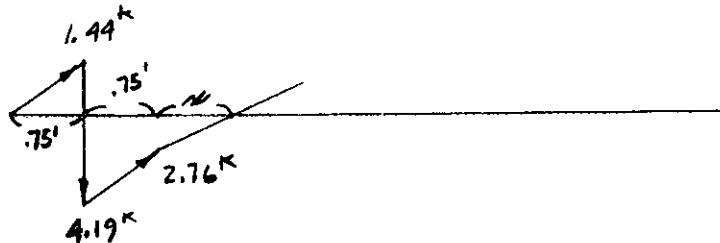
$$\begin{aligned}
 \Sigma M_x & R_A = 25.29 \times 10.60 = -268.0 \uparrow \\
 \text{Conc} & = .160 \times \frac{11.35^2}{2} = -38.6 \\
 P_{T_1} & = 3.42 \times \frac{11.35^2}{2} = +220.0 \uparrow \\
 P_{T_2} & = .0127 \times \frac{11.35^3}{3} = -6.2 \\
 H_2O & = .0625 \times 9.00 \times \frac{9.85}{2} = -27.3 \\
 A_s & = \frac{120.1}{1.44 \times 44} = 1.89 \square
 \end{aligned}$$

Case III ΣM_{RA}

$$\begin{aligned}
 P_{T_1} & = 1.93 \times 22.42 = -43.30 \downarrow \times 10.46 = -452.0 \downarrow \uparrow \\
 P_{T_2} & = \frac{1}{2} \times .58 \times 22.42 = -6.50 \times 6.72 = -43.7 \\
 \text{Conc} & = \dots = +13.45 = +140.8 \downarrow \\
 \text{outside } H_2O & = .0625 \times 6.0 \times 6.0 = +2.25 \times 18.67 = +42.0 \\
 V & = -6.53 \times 21.67 = -141.8 \\
 M & = \underline{\underline{-40.63}} \quad \underline{\underline{-67.1}} \\
 & \quad \quad \quad \underline{\underline{-521.8}}
 \end{aligned}$$

$$R_B = \frac{521.8}{14.92} = +35.0 \uparrow \quad R_A = 40.63 - 35.0 = +5.63 \uparrow$$

$$V = (2.51 - .60) \alpha - .0258 \frac{x^2}{2} = 1.91 \alpha - .0129 \alpha^2$$



$$V = .0129 \alpha^2 - 1.91 \alpha + 2.76 = 0$$

$$\alpha = \frac{1.91 - \sqrt{3.65 - (4 \times .0129 \times 2.76)}}{.0258} = 1.55'$$

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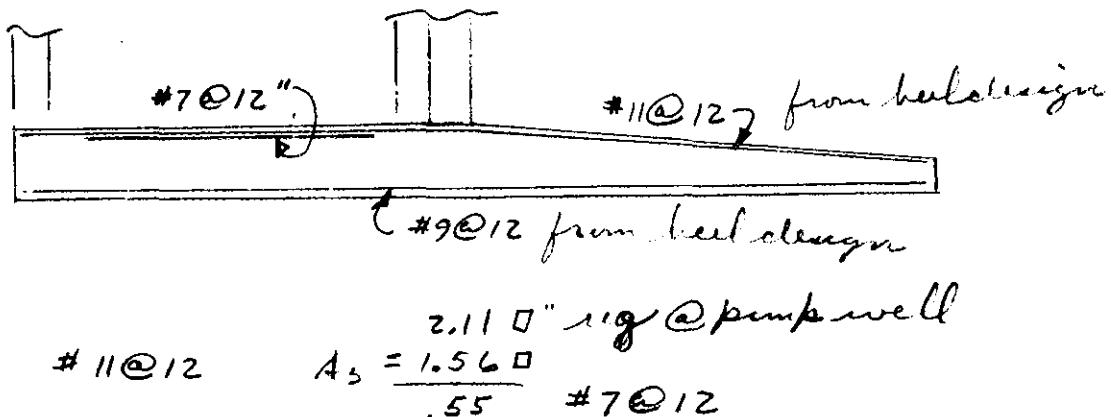
PROJECT Chicopee Falls
 SUBJECT Main St. Pump St.

PROJECT NO. 6205
 SHEET NO. OF
 DATE 3/14/63
 COMPUTED BY JCF
 CHECKED BY JR

$$\begin{aligned}
 R_A &= 5.63 \times 3.51 & - & 19.8 \\
 \text{Conc} &= .60 \times \frac{4.26}{2} & - & 5.4 \\
 P_{T1} &= 2.51 \times \frac{4.26}{2} & + & 22.8 \\
 P_{T2} &= .0129 \times \frac{4.26}{3} & - & 0.3 \\
 && - & 2.7' K
 \end{aligned}$$

$$A_s = \frac{2.7}{1.44 \times 44} = .04 \square"$$

$$\text{min } A_s = .002 \times 12 \times 48 = 1.15 \square"$$



$$\#11@12 \quad A_s = \frac{1.56 \square}{.55} \quad \#7@12$$

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PROJECT CHICOOEE FALLS

SUBJECT MAIN ST PUMPING STATION

PROJECT NO. 620:

SHEET NO. 23 OF

DATE FEB 63

COMPUTED BY CBR

CHECKED BY CBR

SLAB - OVER FILLED CHAMBERS

$$\begin{aligned} \text{FLOOR ELEVATION} &= 89.0 \\ \text{WATER ELEVATION} &= 105.0 \\ \therefore \text{WATER} &= 21.0 \text{ FT} \\ \text{INSIDE DIMENSIONS} &= 6' \times 5.0' \\ 21.0 \times .0625 &= 1.31 \text{ KSF} \end{aligned}$$

$$+M = \frac{1}{4}(1.31)(5+2)^2 = 4.59 \text{ k}$$

$$-M = 1.19(1.31)(7)^2 = 7.14 \text{ k}$$

$$d^2 = \frac{7.140 \times 12}{160 \times 12} = 6.7 \text{ in}^2$$

USING 12" SLAB, $d = 10"$

$$+ A_s = \frac{4.590}{.885 \times 20,000 \times 10} = .026 \text{ in}^2/\text{in} \quad \# 5 @ 12" \text{ C-C}$$

$$- A_s = \frac{7.140}{.885 \times 20,000 \times 10} = .040 \text{ in}^2/\text{in} \quad \# 6 @ 12" \text{ C-C}$$

$$\text{SHEAR } V = 1.15 \text{ wL} = 1.15 \times 1.31 \times 7 = 10.5 \text{ k}$$

$$S = \frac{10,500}{(12) \times (.9) \times (10)} = 97.5 \text{ psi} > 90 \text{ psi}$$

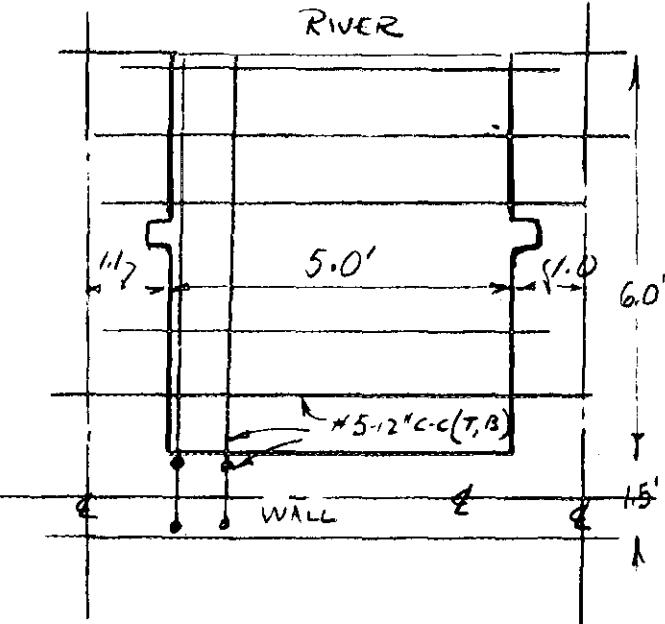
∴ USE 15" SLAB $d = 13.5$ ACTUAL SLAB = 18" USED

$$(\text{II for river}) + A_s = .026 \times \frac{10}{13.5} = .0193 \text{ in}^2/\text{in} \quad \# 5 - 12" \text{ C-C (BOTTOM)}$$

$$- A_s = .040 \times \frac{10}{13.5} = .0296 \text{ in}^2/\text{in} \quad \# 5 - 11" \text{ C-C (TOP)}$$

$$V = 97.5 \times \frac{10}{13.5} = 72 \text{ psi (OK)}$$

USE 5-12" BOTH WAYS TOP + BOTTOM



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PROJECT CHICOREE FALLS
SUBJECT MAIN ST. PUMPING STATION

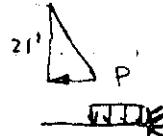
PROJECT NO. 6205-2
SHEET NO. 16 OF 1
DATE FEB 63
COMPUTED BY DR
CHECKED BY J

STOPLOG COLUMNS MIN WIDTH 2'-0"

CONTINUE WALL DESIGN ADJACENT TO STATION TO TIE INTO
STATION USING THE 1'-6" DESIGN BEFORE - REFER TO WALL DESIGN

CONSIDERING 1' CHAMBER FULL AND ONE EMPTY, WITH 21 \pm FT
OF WATER PRESSURE

ABOVE SLAB (AT EL 84.)
3 FT. CANTILEVER FOR
UNIFORM LOAD



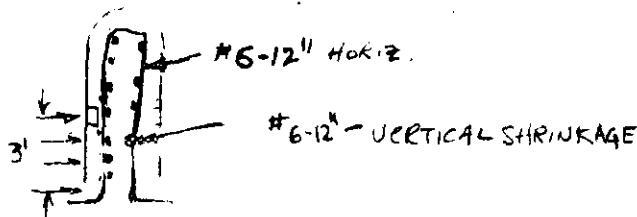
$$P = .0625 \times 21^1 = 1.31 \text{ K/FT UNIFORM LOAD}$$

$$U = 1.31 \times 3' \times 1.5^1 = 5.9^1 \text{ K}$$

CA. FACE - VERTICAL STEEL:

$$A_s = \frac{5,900}{(.907)(27,000)(20)} = .0121 \text{ m}^2/\text{m} \quad \text{AT BOTTOM}$$

[#6-12" ALL THE WAY UP]



HOIST SLAB OR THINCH

$$36'' INTAKE = 11,600'' AT STALL (MACHILLIAN, MILLS)
SAY = \frac{900''}{12,500''} APPARATUS$$

GATE SUPPORT APP. 1'-0" FROM WALL

SLAB WIDTH OF 2FT.

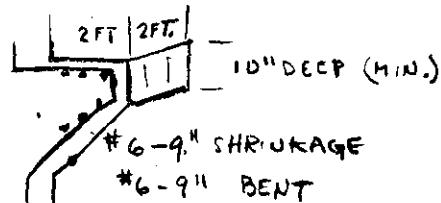
$$M = 12,500 \times 1.0 = 12,500^{\prime\prime}\#$$

$$d = \sqrt{\frac{12,500 \times 12}{160 \times 12}} = 8.8''$$

BENT BARS:

$$A_s = \frac{12,500}{.885(20,000)(8.8)(2\text{FT})} = .040 \text{ m}^2/\text{in}$$

USE #6-9" C-C (.049 m²/in)



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PROJECT CHICOOEE FALLS
 SUBJECT MAIN ST. DUMPING STATION

PROJECT NO. 6205-2
 SHEET NO. 24 OF _____
 DATE FEB 63
 COMPUTED BY DR
 CHECKED BY _____

LOADING #1 (BOTTOM FOOT) EL75.FT

WATER @ 105.0 : $105-75 = 30$ FEET WATER

$$W = .0625 \times 30' = 1.875 \text{ K/FT/FT.} \quad (\text{RIVERSIDE})$$

WATER IN SOIL @ 89.0 : $89-75 = 14$ FEET WATER

$$W = .0625 \times 14' = 0.875 \text{ K/FT/FT.}$$

LATERAL EARTH (14') SATURATED. $\frac{1}{3}[.135 - .0625] = .0242 \text{ K/FT}^3$

$$E = .0242 \times 14' = 0.340 \text{ K/FT/FT.} \quad (\text{LAND SIDE})$$

$$E = .0242 \times 7' = 0.170 \text{ K/FT/FT.} \quad (\text{RIVER SIDE})$$

WATER IN STATION = NEGLIGIBLE ≈ 0 (FOR WORST CASE)

LOADING #1 (EL. 91. FT.)

WATER @ 105.0 : $105-91 = 14$ FEET WATER

$$W = .0625 \times 14 = 0.875 \text{ K/FT/FT.}$$

WATER IN SOIL @ 91 gives NO WATER PRESSURE
 NO SOIL PRESSURE

LOADING #2 (BOTTOM FOOT) (EL. 75 FT.)

WATER @ 102.0 : $102-75 = 27$ FEET WATER

$$W = .0625 \times 27 = 1.69 \text{ K/FT/FT}$$

WATER IN SOIL = 0.875 K/FT/FT

LATERAL EARTH = $0.340 \text{ K/FT/FT.} \approx 0.170 \text{ K/FT/FT}$

WATER IN STATION = NEGLIGIBLE ≈ 0 (WORST CASE)

LOADING #2 (EL 91 FEET)

WATER @ 102.0 : $102-91 = 11$ FEET WATER

$$W = .0625 \times 11 = 0.69 \text{ K/FT/FT}$$

LOADING #3 (EL 75.0 BOTTOM FOOT) (REFER P 8)

WATER AT 80.0 EL., $80-75 = 5$ FEET WATER

$$W = .0625 \times 5 = 0.312 \text{ K/FT/FT}$$

(continued) A-27

PROJECT CHICOREE FALLS

SUBJECT MADST PUMPING STATION

PROJECT NO. 6205-2
SHEET NO. 25 OF 1
DATE FEB 63
COMPUTED BY WR
CHECKED BY JFH

LOADING #3 (continued) BOTTOM FOOT.

Pes : EARTH + T 89.0 ADD 3' SURCHARGE
WATER AT 80.0

(PAGE 8) Pes₁ : .130 x 1/3 x 12 = .520 K/FT/FT ORDINATE

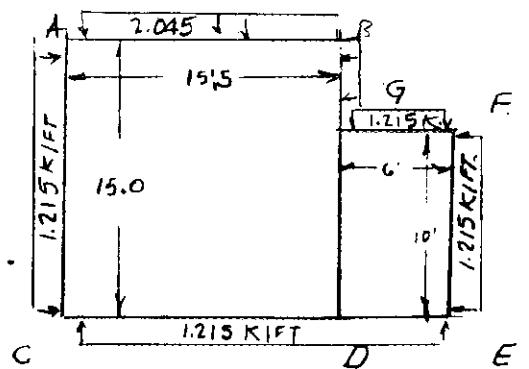
Pes₃ : .0725 x 1/3 x 5 = .121 K/FT/FT ORDINATE

LATERAL (E) = 0.641 K/FT/FT LAND SIDE

LATERAL E = 0.17 K/FT/FT WATER SIDE
WATER INSIDE STATION = NEGLECTABLE

LOADING #1

REFER TO 24cc



I's are \approx the same

$$FEM_{AB-BA} = \frac{1}{2}(2.045)(15.5)^2 = \pm 40.9 'K \quad \therefore K_{AB-BA} = \frac{100}{15.5} = 6.45$$

$$FEM_{AC-CA} = \frac{1}{2}(1.215)(15.)^2 = \pm 22.8 'K \quad \therefore K_{AC-CA} = \frac{100}{15.} = 6.67$$

$$FEM_{CD-DC} = \frac{1}{2}(1.215)(15.5)^2 = \pm 24.3 'K \quad \therefore K_{CD-DC} = \frac{100}{15.5} = 6.45$$

$$FEM_{DE-ED} = \frac{1}{2}(1.215)(6)^2 = \pm 3.6 'K \quad \therefore K_{ED-DE} = \frac{100}{6} = 16.67$$

$$FEM_{EF-FE} = \frac{1}{2}(1.215)(10)^2 = \pm 10.1 'K \quad \therefore K_{EF-FE} = \frac{100}{10} = 10.0$$

$$FEM_{FG-GF} = \frac{1}{2}(1.215)(6)^2 = \pm 3.6 'K \quad \therefore K_{FG-GF} = \frac{100}{6} = 16.67$$

$$FEM_{GB-BG} = \frac{1}{2}(1.215)(5.)^2 = \pm 2.5 'K \quad \therefore K_{GB-BG} = \frac{100}{5.} = 20$$

$$\therefore K_{GD-DG} = \frac{100}{10} = 10$$

GREEN ENGINEERING AFFILIATES

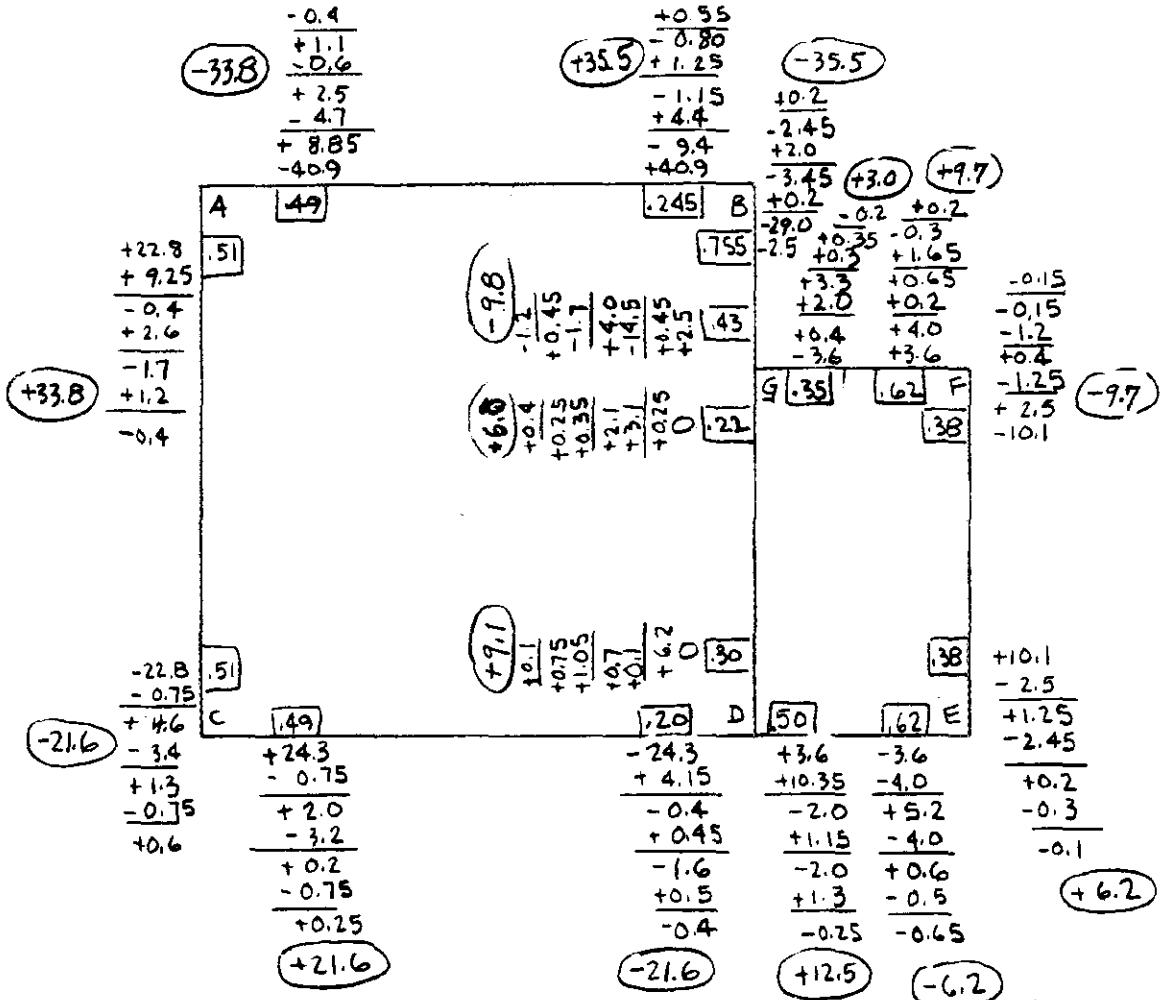
ENGINEERS
BOSTON, MASS.

BOSTON, MASS.

PROJECT CHICOREE FALLS

MANST. PUMPING STATION

PROJECT NO. 6205-2
SHEET NO. 26 OF 4
DATE FEB
COMPUTED BY D.R.
CHECKED BY _____



A-29

GREEN ENGINEERING AFFILIATES
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PROJECT CHICOOEE FALLS
SUBJECT MAIN ST. PUMPING STATION

PROJECT NO. 6205-2

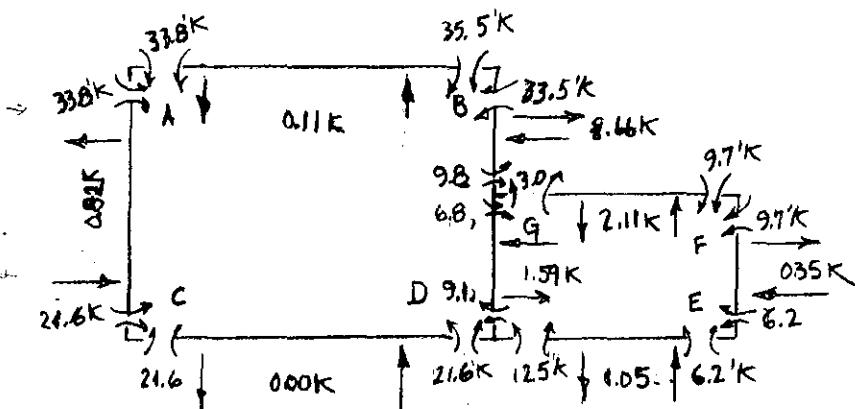
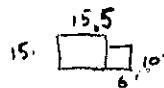
SHEET NO. 27 OF

DATE FEB 63

COMPUTED BY DR

CHECKED BY KIP

LOADING #1 (BOTTOM FOOT)



SHEAR FROM UNIFORM LOADS PLUS ABOVE SHEAR: [UNBALANCE ASSUMED TAKEN BY THIS RIGID STRUCTURE - DISCUSSED THAT THERE WILL BE AN UNBALANCE BUT IT WILL ENTER THE BASE WITH MINOR CHANGES IN MOMENT]

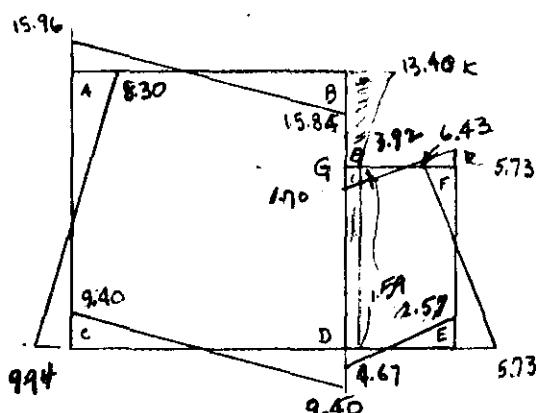
WE/2 + SHEAR:

$$\begin{aligned} AB &= 15.85K \uparrow \pm 0.11K \\ AC &= 9.12K \leftarrow \pm 0.82K \\ CD &= 9.40K \downarrow \pm 0.00K \\ DE &= 3.62K \leftarrow \pm 1.03K \\ EF &= 6.08K \rightarrow \pm 0.35K \\ FG &= 3.62K \uparrow \pm 2.11K \\ GB &= 8.66K \rightarrow \pm 4.74K \\ GD &= 0 \pm 1.59K \end{aligned}$$

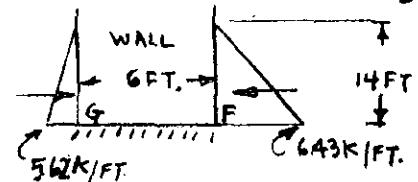
BOTTOM FOOT:



NET = 0.81K BOTTOM FT.



[ASSUMING IF POSSIBLE! G VERTICALLY CAN MOVE FREELY]



(NEGIGLIBLE)

$$M = 14/3 \times 0.81 \times 14/2 = 2.64K\cdot ft$$

$$A_s = \frac{26,400}{907 \times 27,000 \times 68} = .016 \text{ in}^2/\text{in}$$

∴ MIN STEEL VERTICALLY OF

(SEE LATER SHEETS)

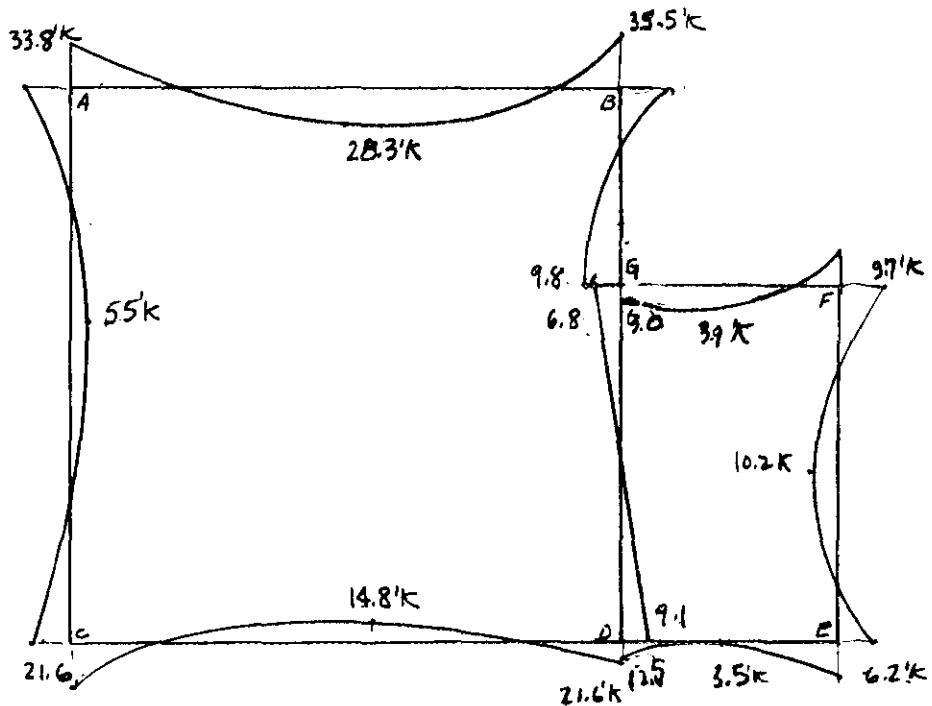
A-30

PROJECT CHICOPEE FALLS

SUBJECT MAIN ST PUMPING STATION

PROJECT NO. 6205-2
SHEET NO. 28 OF _____
DATE FEB 63
COMPUTED BY WP
CHECKED BY JCP

TENSION SIDE LOADING #1 BOTTOM FOOT



(FROM P27)

$$\cdot A-B \rightarrow \frac{15.96}{x_L} = \frac{31.90}{15.5} \nparallel x_L = 7.78' \equiv (15.96)(\frac{1}{2})(7.78) = 62.1 - 33.8 \rightarrow 28.3'k @ 7.78'$$

$$\cdot A-C \rightarrow \frac{8.30}{x_R} = \frac{15.24}{15.0} \nparallel x_R = 6.82' \equiv (8.30)(\frac{1}{2})(6.82) = 28.3 - 33.8 \rightarrow 55'k @ 6.82'$$

$$\cdot C-D \rightarrow x_L = 7.75' \equiv (9.40)(\frac{1}{2})(7.75) = 36.4 - 21.6 \rightarrow 14.8'k @ 7.75$$

$$D-E \rightarrow \frac{2.57}{x_R} = \frac{7.24}{6'} \nparallel x_R = 2.12' \equiv (2.12)(\frac{1}{2})(2.57) = 2.7 - 6.2 \rightarrow 3.9'k @ 2.12'$$

$$E-F \rightarrow \frac{5.73}{x_L} = \frac{12.16}{10} \nparallel x_L = 5.72' \equiv (5.72)(\frac{1}{2})(5.73) = 16.4 - 6.2 \rightarrow 10.2'k @ 5.72'$$

$$G-F \rightarrow \frac{5.73}{x_R} = \frac{7.24}{6'} \nparallel x_R = 4.75' \equiv (5.73)(\frac{1}{2})(4.75) = 13.6 - 9.7 \rightarrow 3.9'k @ 4.75'$$

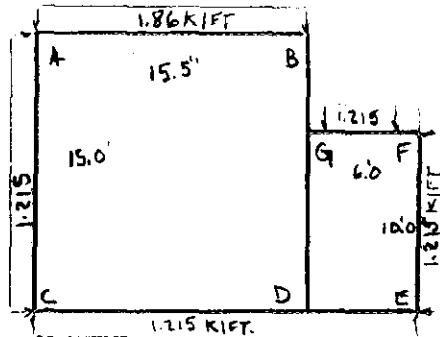
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PROJECT CHICOPEE FALLS

SUBJECT MAIN ST PUMPING STATION

PROJECT NO. 6205.2
 SHEET NO. 29 OF 1
 DATE MAR 63
 COMPUTED BY LDR
 CHECKED BY PB

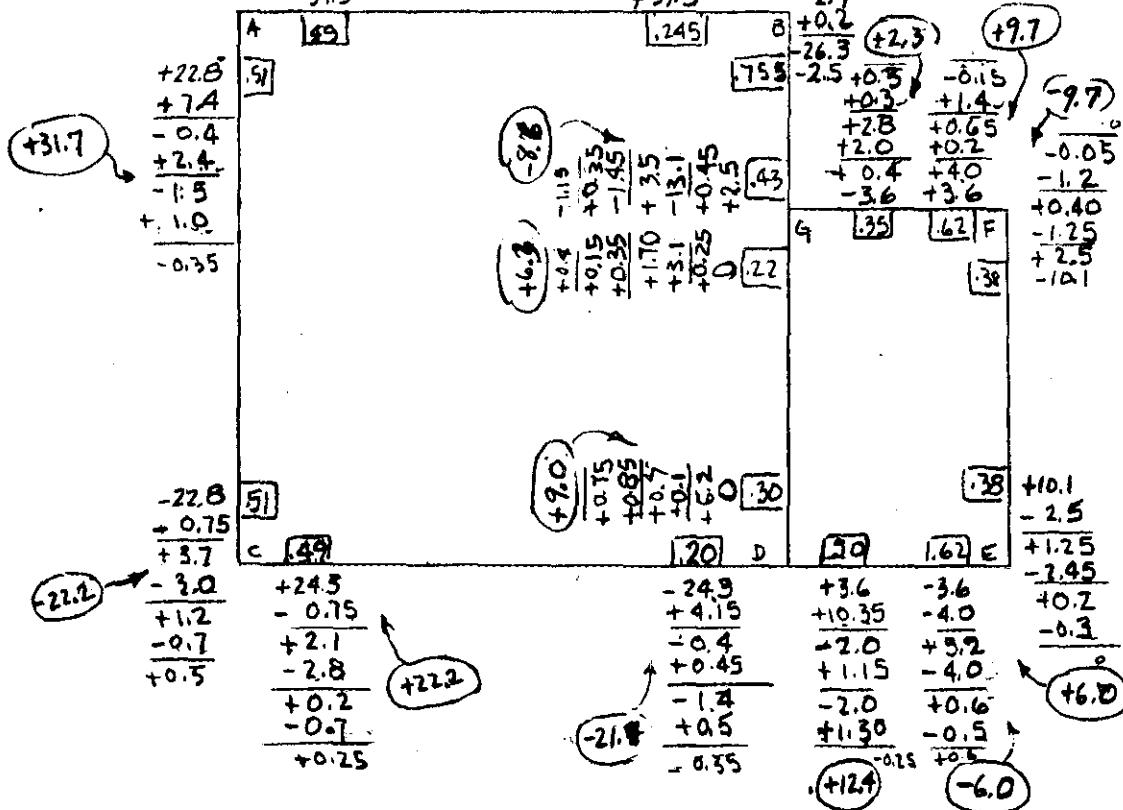
LOADING #2 (REFER TO P24 ETC.)



(REFER P26)

$$\begin{array}{r}
 -0.35 \\
 +0.95 \\
 -0.45 \\
 +2.25 \\
 -4.25 \\
 +7.7 \\
 -37.3
 \end{array}$$

$$\begin{array}{l}
 FEM_{AB-BA} = \frac{1}{2}(1.86)(5.5)^2 = \pm 37.3'K \\
 FEM_{AC-CA} = \pm 22.3'K \\
 FEM_{CD-DC} = \pm 24.3'K \\
 FEM_{DE-ED} = \pm 3.6'K \\
 FEM_{EF-FE} = \pm 10.1'K \\
 FEM_{FG-GF} = \pm 3.6'K \\
 FEM_{GB-BG} = \pm 25'K
 \end{array}$$



A-32

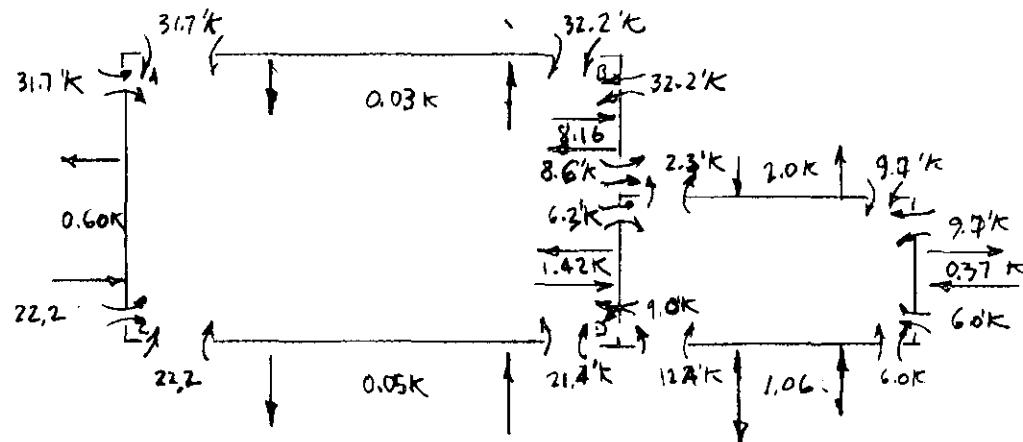
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PROJECT CHICOPEE FALLS

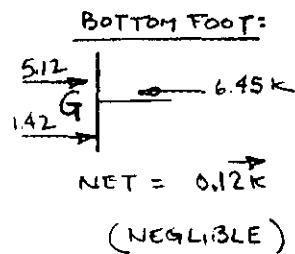
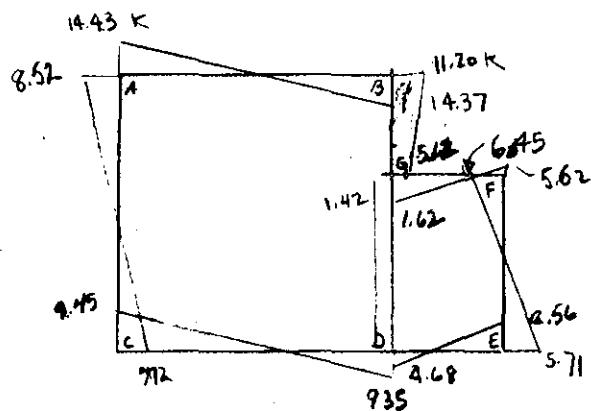
SUBJECT MAIN ST PUMPING STATION

PROJECT NO. 6205-2
 SHEET NO. 30 OF
 DATE MAR 63
 COMPUTED BY DR
 CHECKED BY JL

LOADING #2 (BOTTOM FOOT)



$$\begin{aligned}
 w_{l/2} + \text{SHEAR} : \quad AB &= 14.40K \uparrow \pm 0.03K \\
 AC &= 9.12K \leftarrow \pm 0.60K \\
 CD &= 9.40K \downarrow \mp 0.05K \\
 DE &= 3.62K \uparrow \pm 1.06K \\
 EF &= 6.08K \rightarrow \mp 0.37K \\
 FG &= 3.62K \uparrow \pm 2.00K \\
 GB &= 3.04E \mp 8.16K \\
 GD &= 0 \mp 1.42K
 \end{aligned}$$

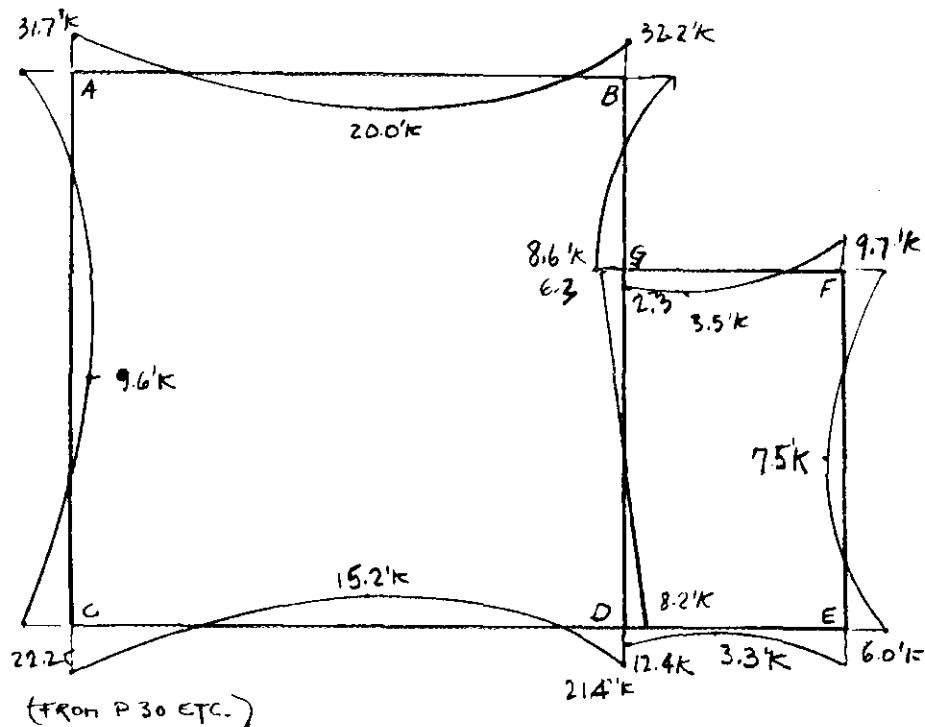


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BOSTON, MASS.

PROJECT NO. 6205-2
 SHEET NO. 31 OF 1
 DATE MAR 63
 COMPUTED BY DR
 CHECKED BY J. J. L.

SUBJECT MAIN ST. PUMPING STATION

TENSION SIDE LOADING @ BOTTOM FOOT



$$AB \rightarrow \frac{14.43}{x_L} = \frac{28.80}{15.5} \quad \text{if } x_L = 7.78' \quad \therefore (14.43)(\frac{1}{2})(7.78) = 55.6'k - 31.7 = 23.9'k @ 7.78'$$

$$AC \rightarrow \frac{9.72}{x_L} = \frac{18.24}{15.0} \quad \text{if } x_L = 8.00' \quad \therefore (9.72)(\frac{1}{2})(8.00) = 38.9 - 22.2 = 16.7'k @ 8.00'$$

$$CD \rightarrow \frac{9.45}{x_L} = \frac{18.80}{15.5} \quad \text{if } x_L = 7.80' \quad \therefore (9.45)(\frac{1}{2})(7.80) = 36.9 - 22.2 = 14.7'k @ 7.80'$$

$$DE \rightarrow \frac{4.68}{x_L} = \frac{7.24}{6.0} \quad \text{if } x_L = 3.88' \quad \therefore (3.88)(\frac{1}{2})(4.68) = 9.1 - 12.4 = -3.3k @ 3.88'$$

$$EF \rightarrow \frac{5.71}{x_L} = \frac{12.16}{10} \quad \text{if } x_L = 4.71' \quad \therefore (4.71)(\frac{1}{2})(5.71) = 13.5 - 6.0 = 7.5k @ 4.71'$$

$$GF \rightarrow \frac{1.62}{x_L} = \frac{7.24}{6} \quad \text{if } x_L = 1.34' \quad \therefore (1.34)(\frac{1}{2})(1.62) = 1.2 + 2.3 = 3.5'k @ 1.34'$$

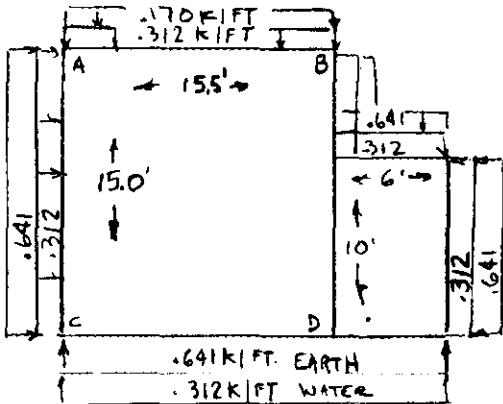
PROJECT CHICOOPEE FALLS

SUBJECT MAIN ST PUMPING STATION

PROJECT NO. 6205-2
 SHEET NO. 32 OF _____
 DATE MAR 63
 COMPUTED BY QRI
 CHECKED BY F.H.P.

LOADING #3

(REFER P24,25)



COMPARING LOADING #3 - LOADING #2

ALL LOADINGS UNDER #3 ARE
 LESS AND THE WALLS BEND SIMILARLY.

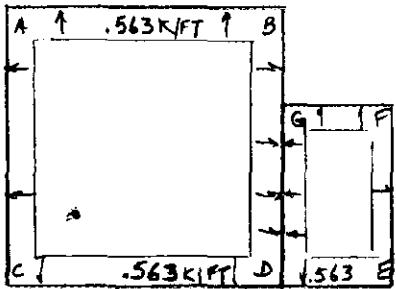
$FEM_{AB} = \frac{1}{2}(482)(15.5)^2 = 9.6'K$ VS. $40.9'K$ et al
 A STATEMENT CAN BE MADE SAYING
 THAT LD. #2 LOADS AND BENDING
 WILL GOVERN AS COMPARED TO LD. #3.

ADDITIONAL LOADING : (BOTTOM FOOT)

[TO BE ADDED TO MAKE MAX. CONDITIONS
 WHERE NEEDED]

WATER ON INSIDE CHAMBERS AT EL. 83.0 \therefore 9 FEET OF WATER

$$.0625 \times 9 = .5625 \text{ k/ft/ft.}$$



$$FEM_{AB-BA} = \frac{1}{2}(563)(15.5)^2 = 11.2'K$$

$$FEM_{CD-DC} = \frac{1}{2}(563)(15.)^2 = 10.5'K$$

$$FEM_{AC-CA} = \frac{1}{2}(563)(6)^2 = 1.7'K$$

$$FEM_{EF-ED} = \frac{1}{2}(563)(10)^2 = 4.7'K$$

$$FEM_{BG-GD} = \frac{1}{2}(563)(5.)^2 = 1.2'K$$

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PROJECT C HICKORY TALLS

PROJECT NO. 6205-2

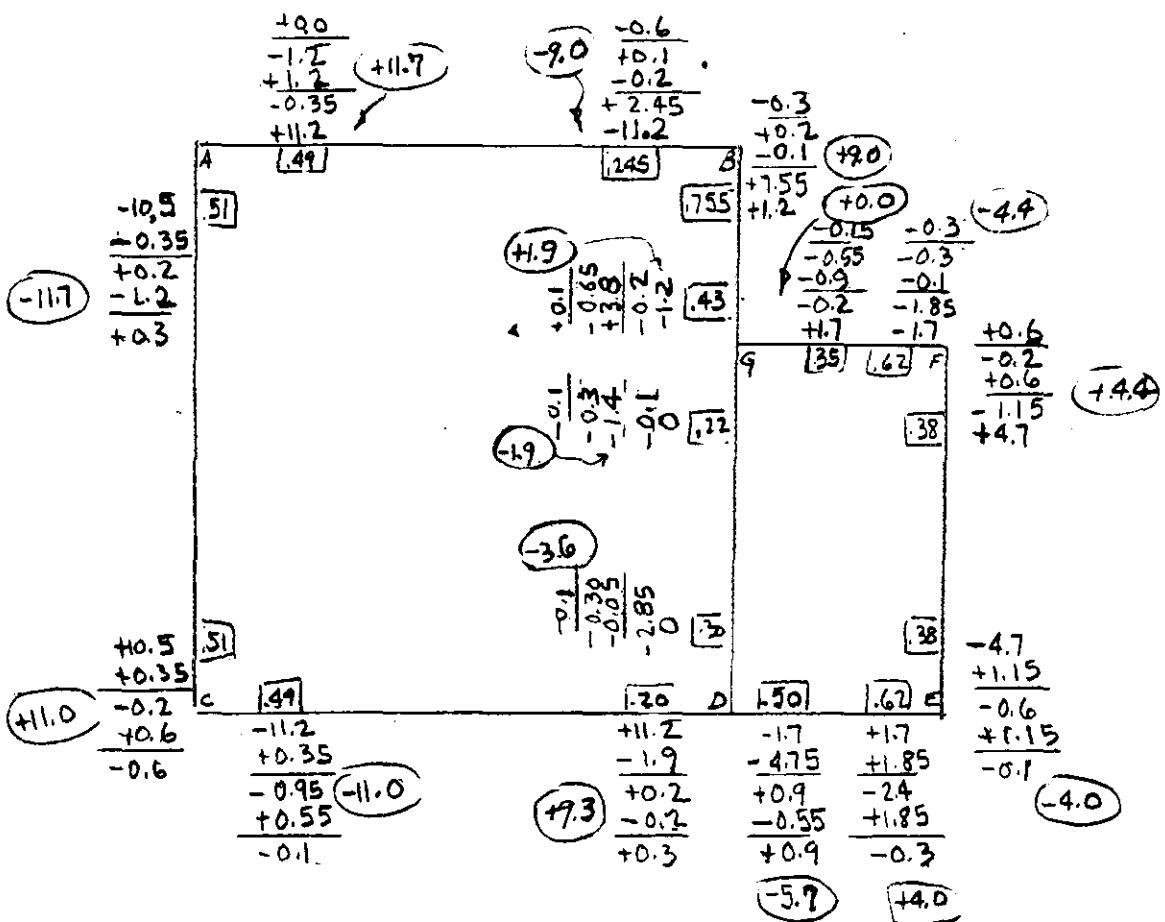
SHEET NO. 33 OF

DATE MAR 63

COMPUTED BY G.R.

SUBJECT MAINST. PUMPING STATION

-ADDITIONAL LOAD: (BOTTOM FOOT)



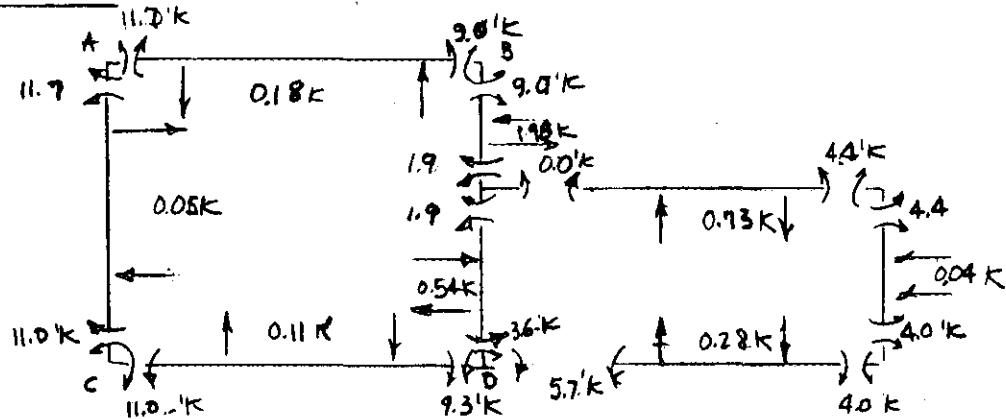
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PROJECT CHICOOPEE FALLS

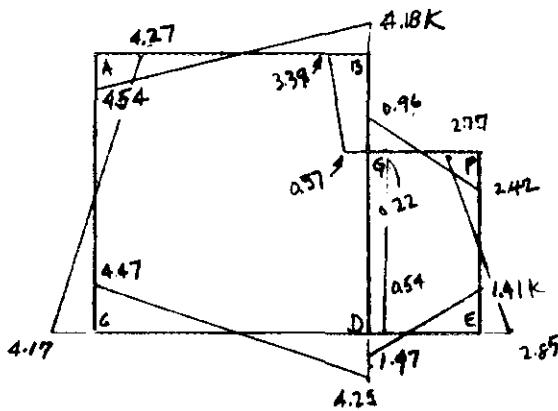
SUBJECT MAIN ST PUMPING STATION

PROJECT NO. 6205-2
 SHEET NO. 34 OF 1
 DATE MAR 63
 COMPUTED BY JDR
 CHECKED BY AS

ADDITIONAL LOAD (BOTTOM FOOT)



$$\begin{aligned}
 w_{p/2} + S\text{HEAR} : AB &= 436 \text{K} \uparrow \pm 0.18 \text{K} \\
 AC &= 4.22 \text{K} \rightarrow \pm 0.05 \text{K} \\
 CD &= 4.36 \text{K} \uparrow \pm 0.11 \text{K} \\
 DE &= 1.69 \text{K} \uparrow \pm 0.28 \text{K} \\
 EF &= 2.81 \text{K} \leftarrow \pm 0.04 \text{K} \\
 FG &= 1.69 \text{K} \downarrow \pm 0.73 \text{K} \\
 BG &\approx 1.41 \text{K} \rightarrow \pm 1.98 \text{K} \\
 GD &= 0 \quad \pm 0.55 \text{K}
 \end{aligned}$$



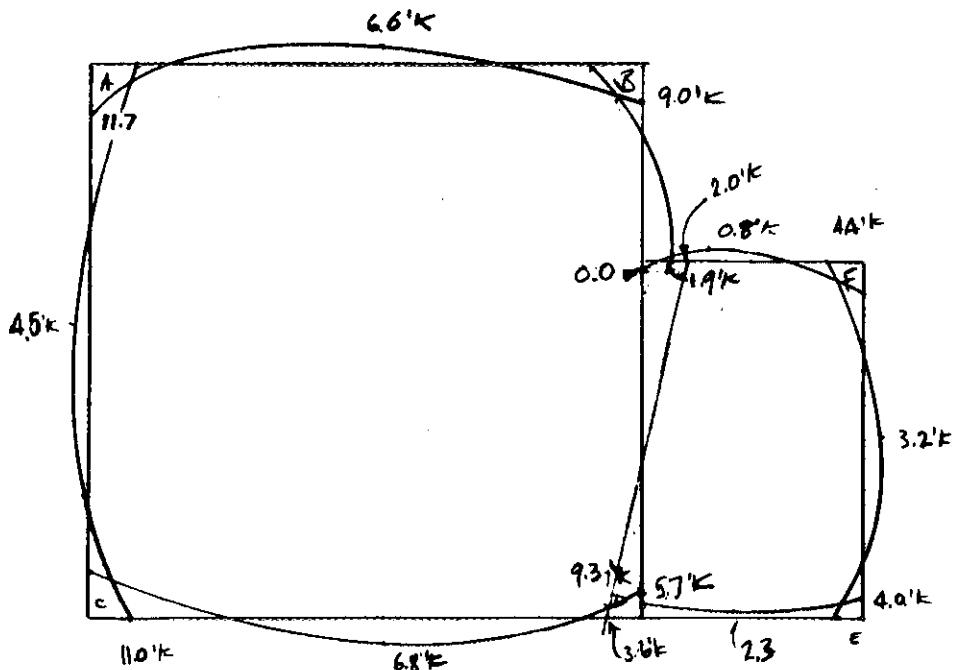
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PROJECT CHICOOEE FALLS

SUBJECT MAIN ST PUMPING STATION

PROJECT NO. 6205-2
 SHEET NO. 35 OF _____
 DATE MAR. 63
 COMPUTED BY P.M.
 CHECKED BY PP

TENSION SIDE (LOADING ADDITIONAL)



$$AB \rightarrow \frac{4.54}{x_L} = \frac{8.82}{15.5} x_L = 8.07' \therefore (4.54)(\frac{1}{2})(8.07) = 18.3 - 11.7 = 6.6'K @ 8.07'$$

$$AC \rightarrow \frac{4.27}{x} = \frac{8.44}{15} x_L = 7.62' \therefore (4.27)(\frac{1}{2})(7.62) = 16.2 - 11.7 = 4.5'K @ 7.62'$$

$$CD \rightarrow \frac{4.47}{x_L} = \frac{8.72}{15.5} x_L = 7.95' \therefore (4.47)(\frac{1}{2})(7.95) = 17.8 - 11.0 = 6.8'K @ 7.95'$$

$$DE \rightarrow \frac{1.97}{x_L} = \frac{3.38}{6} x_L = 3.50' \therefore (1.97)(\frac{1}{2})(3.50) = 3.4 - 5.7 = -2.3'K @ 3.50'$$

$$EF \rightarrow \frac{2.85}{x_L} = \frac{5.62}{10} x_L = 5.08' \therefore (2.85)(\frac{1}{2})(5.08) = 7.2 - 4.0 = 3.2'K @ 5.08'$$

$$G-F \rightarrow \frac{0.98}{x_L} = \frac{3.38}{6} x_L = 1.70' \therefore (0.98)(\frac{1}{2})(1.70) = 0.8 - 0.0 = 0.8'K @ 1.70'$$

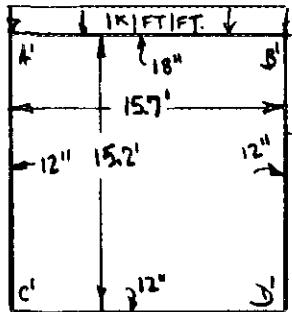
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PROJECT CHICOPEE FALLS

SUBJECT MAINST PUMPING STATION

PROJECT NO. 6205-2
 SHEET NO. 36 OF _____
 DATE MAR 63
 COMPUTED BY QR
 CHECKED BY PP

UNIT LOADING : {WALL DESIGN EL. 91.0}

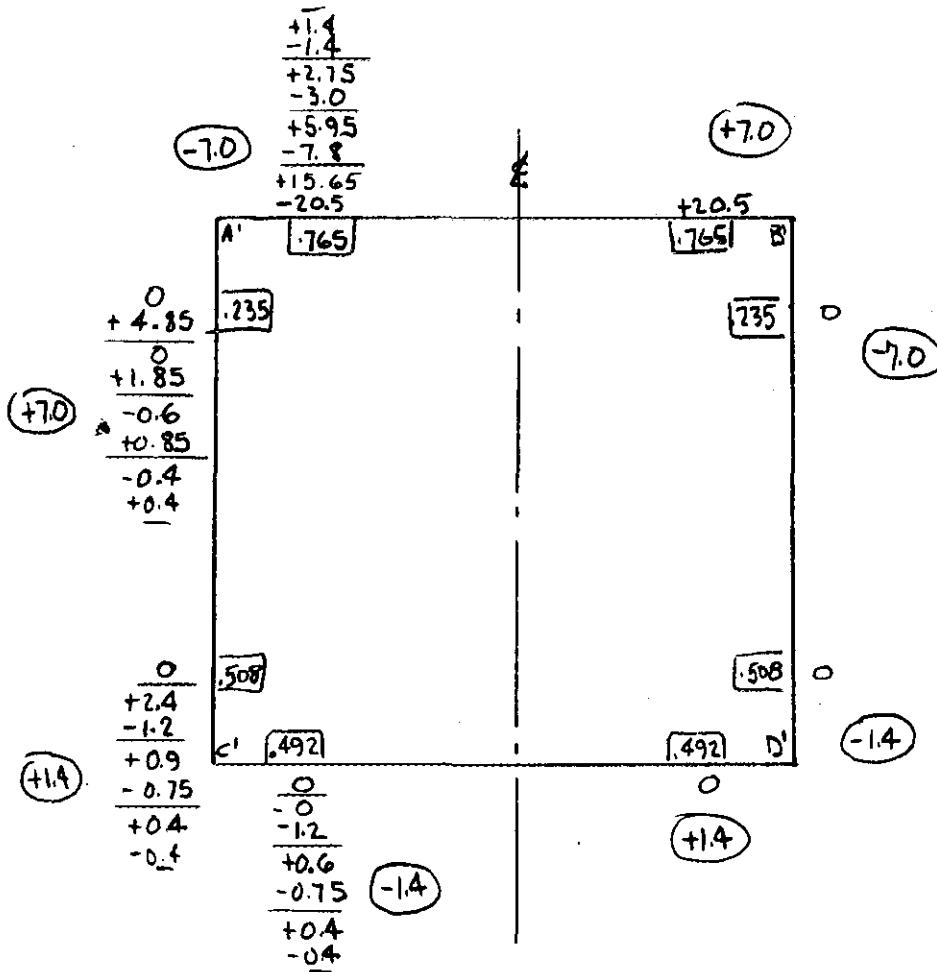


$$FEM_{AB-BD} = \frac{1}{2}(1)(15.7)^2 = 20.5 \text{ k}$$

$$K_{AB-BD} = \frac{100}{15.7} = 6.38$$

$$K_{AC-CA} = \left(\frac{12}{18}\right)^3 \left(\frac{100}{15.2}\right) = 1.95$$

$$K_{CD-DC} = \left(\frac{12}{18}\right)^3 \left(\frac{100}{15.7}\right) = 1.89$$



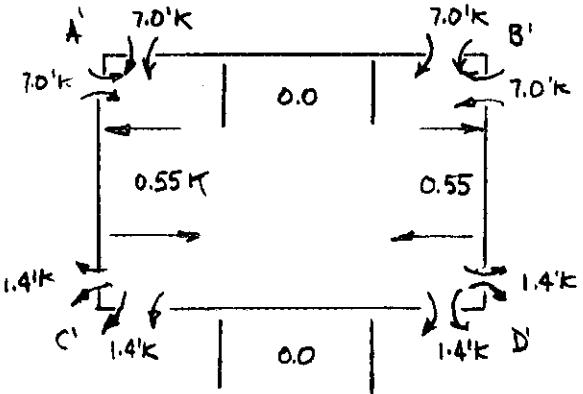
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PROJECT CHICOREE FALLS

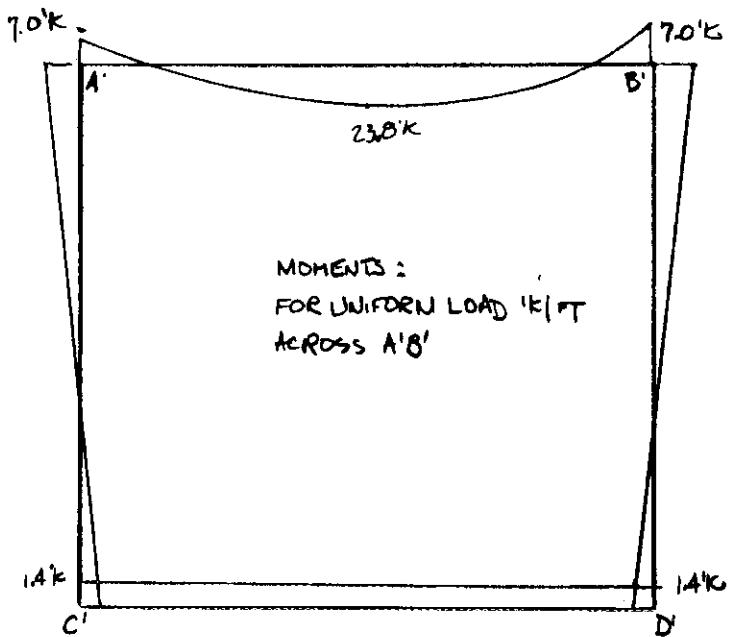
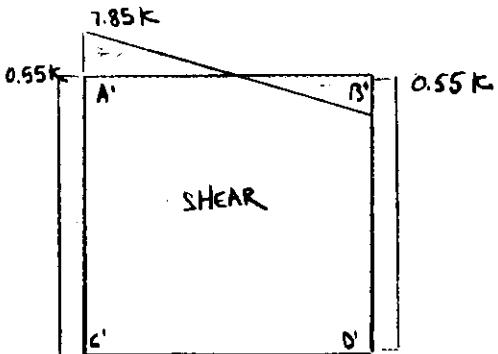
SUBJECT MAIN ST. PUMPING STATION

PROJECT NO. 1.30-2
SHEET NO. 37 OF _____
DATE MAR 63
COMPUTED BY DR
CHECKED BY PP

WALL DESIGN EL 91.0 (UNIT LOADING)



W_b/2 + SHEAR
 $A'B' = 7.85 \uparrow \pm 0'k$
 $A'C = 0 \pm 0.55'k$
 $C'D = 0 \pm 0.00$
 $B'D = 0 \pm 0.55'k$



$$AB \rightarrow (7.85 \times \frac{1}{2})(5.7) = 30.8'k$$

$$30.8 - 7.0 = 23.8'k$$

MOMENTS:
FOR UNIFORM LOAD 'k/ft'
ACROSS A'B'

A-40.

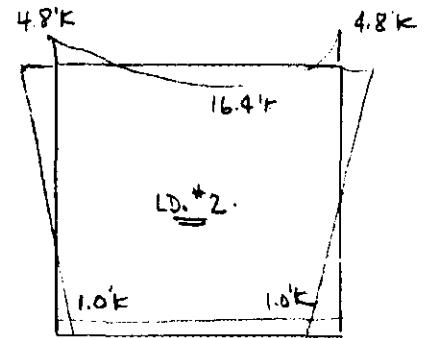
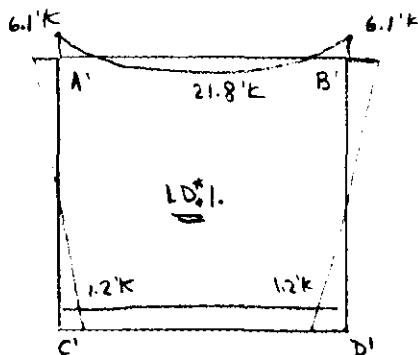
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PROJECT CHICOOPEE FALLS
 SUBJECT MAIN ST. PUMPING STATION

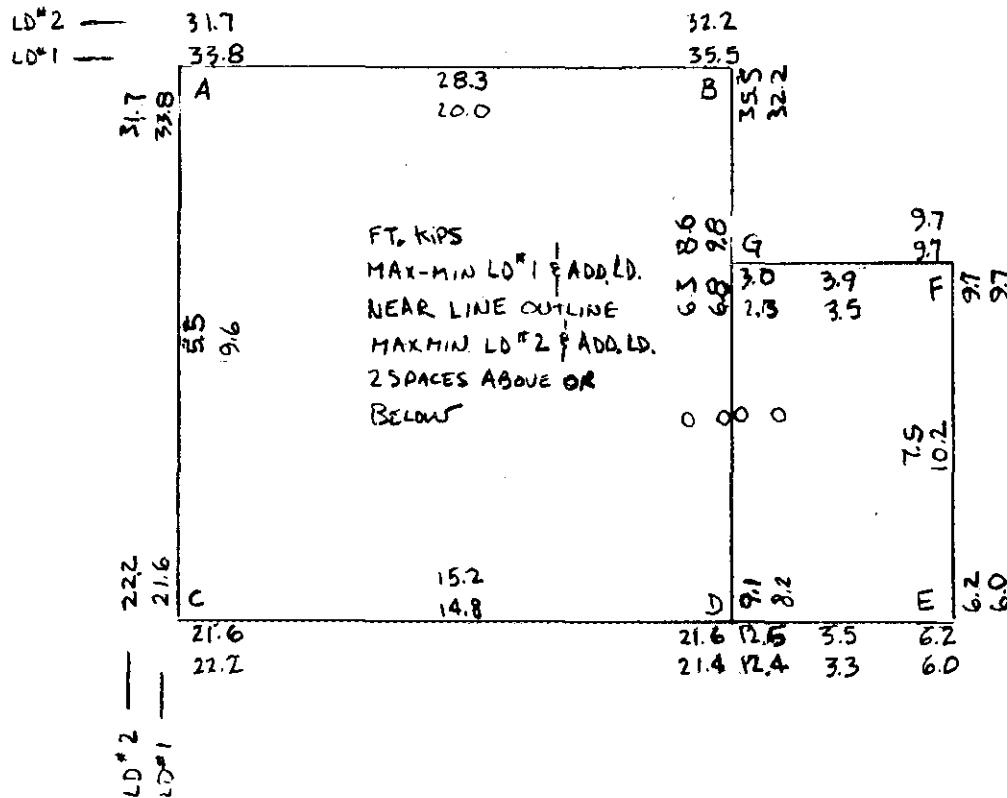
PROJECT NO. 6205
 SHEET NO. 38 OF 12
 DATE MAR 63
 COMPUTED BY DR
 CHECKED BY PP

LOADING #1 @ EL 91.0 (REFER P.37) 0.875 K/FT ACROSS A'B'
 $[\therefore 7.0 \times .875 = 6.1'k \text{ IN A'B'}]$

LOADING #2 @ EL. 91.0 (REFER P.37) 0.69 K/FT ACROSS A'B'



SUMMARY: (BOTTOM FOOT) REFER PREVIOUS PAGES (MAX-MIN) [ON TENSION SIDE]
 (ADDITIONAL LOAD USED P32)*



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PROJECT Chicopee Falls
 SUBJECT Main Street Pump Sta.

PROJECT NO. 6205
 SHEET NO. _____ OF _____
 DATE 1/13/13
 COMPUTED BY J.P. Palmer
 CHECKED BY _____

Vertical Reinf in walls

12" wall

$$A_s = .002 \times 12 \times 12 = .29 \text{ in}^2 \text{ or } .15 \text{ in}^2/\text{ea face}$$

18" wall

$$A_s = .002 \times 12 \times 18 = .43 \text{ in}^2 \text{ or } .22 \text{ in}^2/\text{ea face}$$

} use #6@12"
 ea face
 USE "S-12" ABOVE
 EL. 90.0

Base slab

$$\text{Min } A_s = .002 \times 12 \times 48 = 1.15 \quad \# 11 @ 16"$$

USE: MAX #6-12" C-C

•
 •

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PROJECT CHICORÉE FALLS

SUBJECT MAIN ST PUMPING STATION

PROJECT NO. 6205-2

SHEET NO. OF

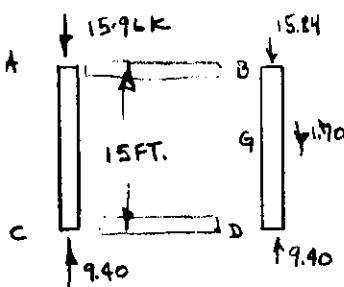
DATE MAR 63

COMPUTED BY VDA

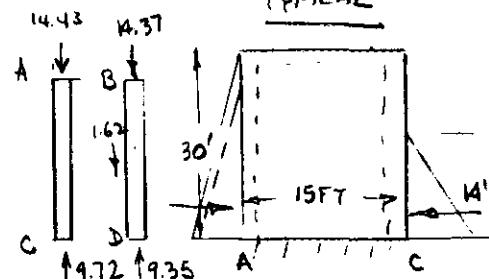
CHECKED BY _____

BOTTOM FT. - UNBALANCED SHEAR

P.A.30-



P.A-33



$$V = 15.9 \times 30/2 - 9.40 \times 14/2 = 172 \text{ K}$$

$$\sigma = \frac{172,000}{15 \times 1.5 \times 144} = 53 \text{ PSI (OK)}$$

AVE LD. AT BOTTOM FT.

$$\downarrow (15.94 + 15.96) \frac{1}{2} = 15.95 \text{ K}$$

$$\uparrow 9.40 \text{ K}$$

$$M = 15.95 \times 30^2/6 - 9.40 \times 14^2/6$$

$$M = 2510 \text{ K} - 307 \text{ K} = 2203 \text{ K}$$

CONSIDERING THE BOX
REFER P4. R.C. HAND BOOK: to be

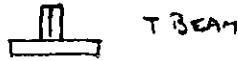
AVE LD. AT BOTTOM FT.

$$\downarrow (14.43 + 15.99) \frac{1}{2} = 15.21 \text{ K}$$

$$\uparrow (9.72 + 9.35) \frac{1}{2} = 9.53 \text{ K}$$

$$M = 15.21 \times 27^2/6 - 9.53 \times 14^2/6$$

$$M = 1850 - 311 = 1539 \text{ K}$$



$$f_s = 27,000 \text{ psi}$$

$$f_c = 1400 \text{ psi}$$

$$d = 15 \text{ FT} - 9'' \text{ AVE} = 14.2 \text{ FT}$$

$$b = 15.5 \text{ FT.}$$

$$M = 2203 \text{ K}$$

$$t = 1.5'' \quad t/d \approx .105$$

$$k = 115 \text{ (TABLE 8)}$$

$$b \times d = 220 \times 144 = 31,700 \times 12 \times 155$$

$$F = \frac{b \times d^2}{12,000} = 451,$$

$$M = 2203 = 2203$$

$$kF = 115 \times 451 = 51900$$

$$M - kF = 49,700$$

$$a = 2.14 \text{ (TABLE 8)}$$

$$A_s = \frac{2.703}{2.14 \times 14.2 \times 12} = 6.07 \text{ in}^2 / 15.5 \text{ FT.}$$

$$A_s = 0.39 \text{ in}^2 / \text{FT} < *6@12'' \text{ BOTH FACES ARE OK.}$$

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PROJECT CHICOPEE FALLS

SUBJECT MAIN ST PUMPING STATION

PROJECT NO. 6205-2
 SHEET NO. 39 OF _____
 DATE MAR 63
 COMPUTED BY DRJ
 CHECKED BY RPT
 754.00

STEEL REFER TO P. 38 $d = 18'' - 3.5 = 14.5''$

@ A OUTSIDE : $A_s = \frac{31,700}{(14.5)(20,000)(.885)} = 0.124 \text{ m}^2/\text{in}$ LD#2
 $(257,000)$ [$\#9-8''$ OR $\#8-6\frac{1}{2}''$]]

AB \pm MID PT : $A_s = \frac{28,300}{(14.5)(27,000)(.91)} = 0.0798 \text{ m}^2/\text{in}$ LD#1
 $(355,000)$ [$\#8\frac{1}{2}$ OR $\#7-7\frac{1}{2}''$]]

@ B OUTSIDE : $A_s = \frac{32,200}{257,000} = 0.125 \text{ m}^2/\text{in}$ LD#2
 [$\#9-8''$ OR $\#8-6\frac{1}{2}''$]]

AC \pm MID PT. $A_s = \frac{9,600}{355,000} = 0.027 \text{ m}^2/\text{in}$ LD#1
 (INSIDE) [$\#5-12''$]]

@ C OUTSIDE : $A_s = \frac{22,000}{257,000} = 0.0868 \text{ m}^2/\text{in}$ LD#2
 [$\#8-9''$ etc]]

CD \pm MID PT. $A_s = \frac{15,200}{257,000} = 0.0592 \text{ m}^2/\text{in}$ LD#2
 (OUTSIDE) [$\#7-10''$ OR $\#6-7\frac{1}{2}''$]]

@ D OUTSIDE LT. $A_s = \frac{21,400}{257,000} = 0.0813 \text{ m}^2/\text{in}$ LD#2
 [$\#6-8\frac{1}{2}''$ OR $\#7-11\frac{1}{2}''$]]

@ D OUTSIDE RT $A_s = \frac{12,400}{(11.5)(20,000)(.885)} = 0.0608 \text{ m}^2/\text{in}$ LD#2
 $(204,000)$ [$\#7-10''$]]

DE \pm MID PT : $\#5-12''$ (INSPECTION)

@ E OUTSIDE : $A_s = \frac{6,000}{204,000} = 0.0294 \text{ m}^2/\text{in}$ LD#2
 [$\#5-11''$]]

EF \pm MID PT : $A_s = \frac{7,500}{204,000} = 0.0368 \text{ m}^2/\text{in}$ LD#2
 [$\#6-12''$]
 [$\#5-8''$]]

A-44

GREEN ENGINEERING AFFILIATES
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PROJECT CHICOPEE FALLS

SUBJECT MAIN ST. PUMPING STATION

PROJECT NO. 6205-2
 SHEET NO. 40 OF 1
 DATE MAR 63
 COMPUTED BY DR
 CHECKED BY RCP

STEEL BOTTOM FOOT CONTINUED

$$@ F outside \quad A_s = \frac{9,700}{201,000} = 0.0475 \text{ in}^2/\text{in} \quad [\# 6-9" C-C] \quad 40" 2$$

F9 M-D POINT [#5-12" C-C]

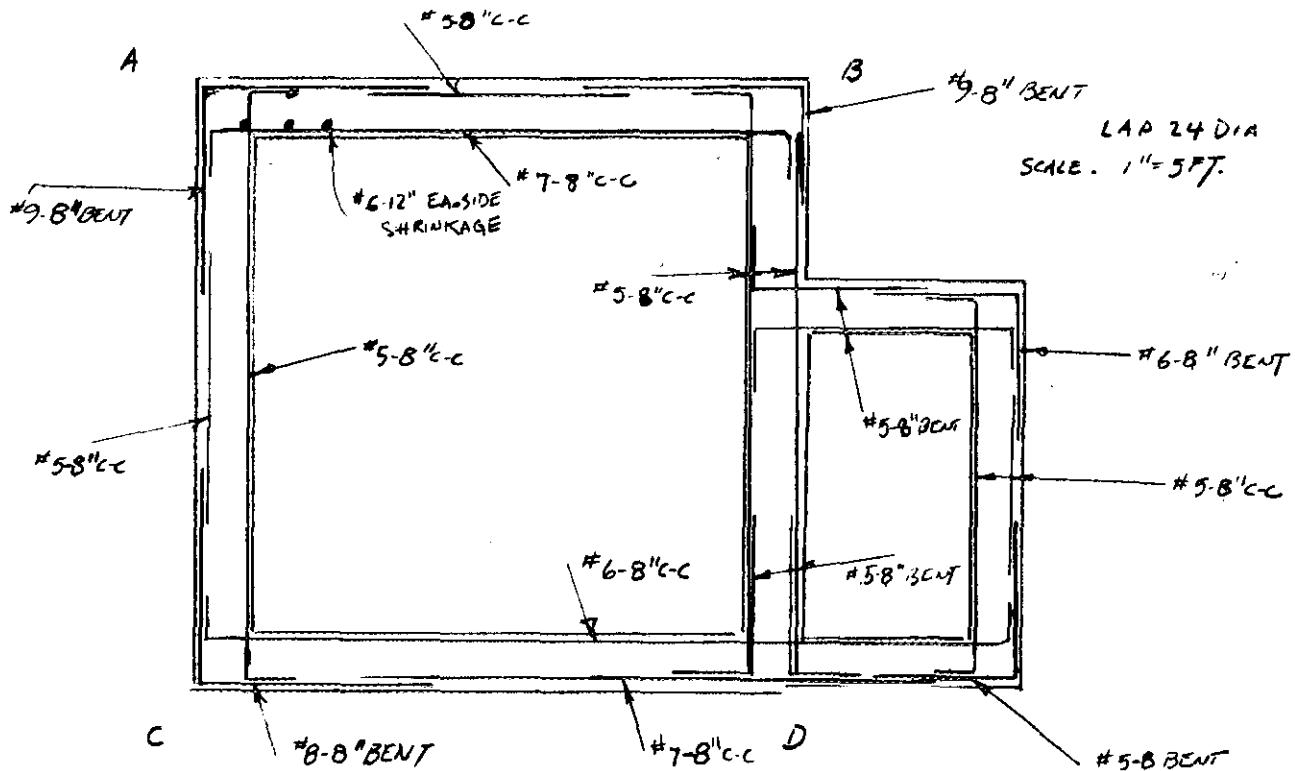
@ G INSIDE [#5-12" C-C]

G9 MIDPOINT 0

$$@ G SOUTH SIDE \quad A_s = \frac{9,800}{257,000} = 0.0381 \text{ in}^2/\text{in} \quad [\# 6-11\frac{1}{2}" C-C]$$

$$@ D NORTH SIDE \quad A_s = \frac{8,200}{257,000} = 0.0319 \text{ in}^2/\text{in} \quad [\# 5-10" C-C]$$

RIVERSIDE - BOTTOM FOOT TO EL. 91.0



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PROJECT CHICOGEE FALLS

SUBJECT MAIN PUMPING STATION

PROJECT NO. 6205-2
 SHEET NO. 41 OF _____
 DATE MAR 63
 COMPUTED BY JW
 CHECKED BY PCP

EL. 91.0 AND UP

REFCR P38

$$d = 12 - \frac{1}{2} - 1\frac{1}{2} = 10^{\frac{1}{2}}$$

(a) A' outside

$$A_s = \frac{6,100}{(907)(27,000)(10)} = 0.025 \text{ in}^2/\text{in} \quad \underline{LD^* 1 -}$$

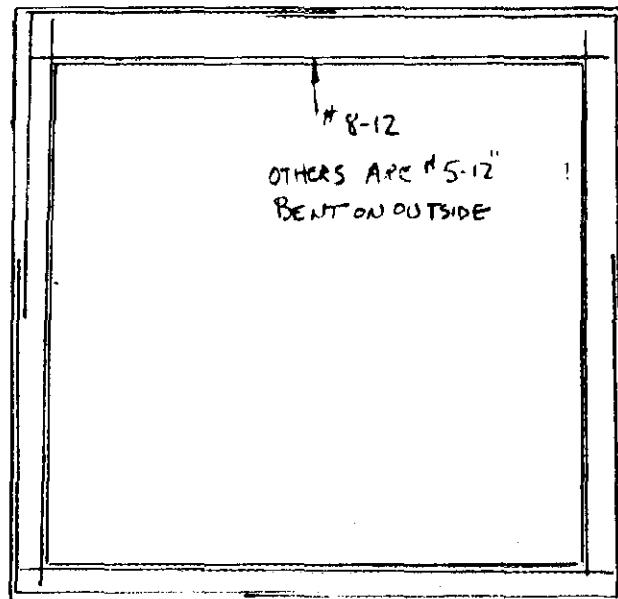
$$A_s = \frac{4,800}{(885)(20,000)(10)} = 0.0271 \text{ in}^2/\text{in} \quad \underline{LD^* 2 - \# 5-12}$$

- A' B' -

$$A_s = \frac{16,400}{257,000} = 0.0638 \text{ in}^2/\text{in} \quad \underline{LD^* 2} \\ [\# 8-12]$$

$$d = 18'' - 3\frac{1}{2}'' \text{ AS BELOW} \\ d = 18'' - 3\frac{1}{2}'' - .5'' = \underline{14.5''}$$

— RIVER SIDE —



LAP = 24 DIA

1'' = 5' SCALE

#5-12" SHRINKAGE

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PROJECT CHICOPEE FALLS

SUBJECT OAK ST PUMPING STATION

PROJECT NO. 6205-2
 SHEET NO. 1 OF 1
 DATE FEB 18, 1962
 COMPUTED BY ENW
 CHECKED BY M.A.

I. DEAD LOAD ONLY

EAST - WEST DIRECTION
 MOMENTS AT WEST WALL

REF ARCH.

PLATES #11 & 12

MARK	FACTORS	↓	↑	PRM	M ₁	M ₂
BASE SLAB C ₁	0.15x2.5x21.0x27.92	219		10.5	2300	
do C ₂	0.15x3.0x3.0x21.0	28		10.5	294	
do C ₃	0.15x2.0x6.75x21.0	42		10.5	441	
do C ₄	0.15x2.0x2x8.0x8.0	38		25.0	935	
W. WALL OUTLET CH.	0.15x1.5x12.67x24.25	69		0.75	52	
do SUMP	0.15x1.5x15.17x13.06	44		0.75	33	
do PUMP	0.15x1.0x15.08x14.19	32		0.5	16	
HOLE - FAN	0.15x1.0x2.5x2.5		1	0.5		1
W. WALL INTAKE	0.15x1.25x6.75x13.0	16		0.62	10	
do LOUVER	0.15x1.5x4.0x6.0		5	0.75		4
E. WALL OUTLET	0.15x1.5x12.67x13.37	31		20.25	625	
do do	0.15x1.42x12.67x13.52	36		20.2	730	
HOLE - GATE	0.15x1.5x4.0x4.0		5	20.25		101
E. WALL - SUMP	0.15x1.5x15.17x13.06	45		20.25	910	
do - PUMP	0.15x1.0x15.08x14.19	32		20.42	653	
DOOR	0.15x1.0x5.0x7.0		5	20.42		103
WINDOW	0.15x1.0x5.0x5.0		3	20.42		70
HOLE	0.15x1.0x1.0x1.3		1	20.42		20
CENTER WALL	0.15x1.5x18.0x10.73	44		10.5	460	
do	0.15x1.25x18.0x14.19	48		10.5	500	
HOLES	3x0.15x1.5x2x2		3	9.5		28
		124	23		7922	327
		23			-327	
		101			7595	

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PROJECT CHICOPEE FALLS

SUBJECT OAK ST. PUMPING STATION

PROJECT NO. 6205-2
 SHEET NO. 2 OF 1
 DATE Feb. 18, 1963
 COMPUTED BY F.H.W.
 CHECKED BY M.A.

MARK	FACTORS	↓	↑	ARM	MT	M
S. WALL	0.15x1.5x18.0 x10.73	44		10.5	460	
do	0.15x1.42x18.0 x13.52	52		10.5	545	
N. WALL	0.15x1.5x18.0 x13.06	53		10.5	545	
do	0.15x1.0x18.92 x14.19	41		10.5	430	
HOLeS	0.15x1.5x5x3x2		7	7.5		52
do	0.15x1.0x5x3x3		7	9.5		67
N. WALL INTAKE	0.15x1.25x26.5x13.0	64		14.5	930	
EAST END	0.15x1.25x16.0 x13.0	15		28.38	425	
GATEWALL	0.15x1.25x5.5 x13.0	13		20.38	262	
HOLE	0.15x1.25x4x4		3	20.36		61
S. WALL INTAKE	0.15x1.25x6.75 x13.0	16		24.38	390	
HOLE	0.15x1.25x17x2 ²		2	24.38		49
COVER	0.15x0.5x5.5x26.5	11		14.50	160	
HOLE	0.15x0.5x5.5x2.0		1	16.0		16
E. INTAKE	0.15x1.25x10x10	19		28.38	540	
	0.15x1.25x6.75 x10.2	25		24.38	610	
HOLeS	0.15x1.25x17x2 ² x2		5	24.38		122
COVER	0.15x0.5x5.5x6.75	3		24.38	73	
DISCHARGE	0.15x1.0x4.5x18.0	12		10.5	126	
IF	0.15x1.0x5.0x18.0	14		10.5	147	
GRAVE	0.135x3.5x5.0 x18.0	42.5		10.5	445	
PIERS	0.15x4.5x6.25 x18.25	77		9.6	740	
STOP LOGS	36/4 x1x4.17x.04	115		10.5	16	
do	48/4 x1x6.5x.04	3		17.25	51	
INTAKE COVERS	0.15x0.5x3x3x2		1	26		26
OM, MED (A)	ARM M			506	26	
.15x2.25x1.5x18.25=9	18.37=165 ⁻			26		
				480		
					6895	393
					373	
					6502	

13-2

PROJECT CHICOOPEE FALLS

SUBJECT OAK ST. PUMPING STATION

PROJECT NO. 6205
SHEET NO. 3 OF 1
DATE Feb. 19, 1963
COMPUTED BY FNW
CHECKED BY M.A.

I. Cont. Dead Load. East-West Direction.
Moments at West Wall.

Mark	Factors	↓	↑	Arm	M	FM
Roof	$0.15 \times 0.5 \times 18.0 \times 10'$	13.5		10.5	142	
do	$0.15 \times 0.5 \times 14.08 - 18.83$	19.8		10.5	208	
Holes	$0.15 \times 0.5 \times 2.0 \times 3.0 \times 3$		1.3	9.0		12
do	$0.15 \times 0.5 \times 2.0 \times 6.0$		1.	18		18
do	$0.15 \times 0.5 \times 3.5 \times 2.5$		1 0.7	2.5		2
Parapet	$0.15 \times 1.0 \times 2.0 \times 9.4$ $= (2 \times 28 + 2 \times 19)$	28.2		10.5	296	
Crane Rails	$(.031 + .035) \times 55'$	3.5		10.5	37	
Pump Rm Floor	$0.15 \times 1.0 \times 14.08 - 18.93$	40.		10.5	420	
Holes	$0.15 \times 1.0 \times 2' \times 2' \times 3$		1.8	9.5		17
do	$0.15 \times 1.0 \times 1 \times 1.25 \times 2$		0.4	10.5		4
do	$0.15 \times 1.0 \times 2.5 \times 2.5$		1.0	18		18
do	$0.15 \times 1.0 \times \pi \cdot 3^2/4$		1.0	3.1		3
See Below		105	7.2		1103	74
		7			1029	
		98			7842	
		712			6527	
		481			15398	
				1291		

→ PUNPRM FLOOR. ARM M
 $.15 \times 13.42 \times 18.0 = 36.2$ 10.5 380

CORRECT. PUMP RM. SL

ADDITION, (A)

- 4

+ 9

1296

- 40

+ 163

15523

Note: For purposes of weight, pump room floor is considered to be a 12' slab. B-3

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PROJECT CHICOOPEE FALLS

SUBJECT OAK ST. PUMPING STATION

PROJECT NO. 6205
 SHEET NO. 4 OF 1
 DATE Feb. 19, 1963
 COMPUTED BY F.N.W.
 CHECKED BY M.A.

I. Dead Load Only.

North-South Direction.
 Moments at South Wall

Mark	Factors	b	t	Arm	M_{\downarrow}	M_{\uparrow}
Base Slab ✓		219 ✓		13.96 ✓	3060 ✓	
do 4 ✓		28 ✓		11.65 ✓	322 ✓	
do ✓		42 ✓		30.5 ✓	1280 ✓	
do ✓		38 ✓		17.65 ✓	1733 ✓	660 ✓
W. Wall ✓		69 ✓		6.33 ✓	437 ✓	
do ✓		44 ✓		20.33 ✓	892 ✓	
do ✓		32 ✓		20.3 ✓	650 ✓	
Hole ✓			1. ✓	1. ✓	16 ✓	16 ✓
W. Wall ✓		16 ✓		31.3 ✓	500 ✓	
Hole ✓			5. ✓	4.25 ✓		21 ✓
E. Wall ✓		31 ✓		6.38 ✓	198 ✓	
do ✓		36 ✓		6.38 ✓	229 ✓	
Hole ✓			5 ✓	4.25 ✓		21 ✓
E. Wall ✓		45 ✓		20.3 ✓	913 ✓	
do ✓		32 ✓		20.3 ✓	650 ✓	
Door ✓			5 ✓	16.25 ✓		81 ✓
Window ✓			3 ✓	23.25 ✓		70 ✓
Hole ✓			1 ✓	23.25 ✓		23 ✓
Center wall ✓		44 ✓		12.25 ✓	538 ✓	
do ✓		48 ✓		12.13 ✓	580 ✓	
Holes ✓			3 ✓	12.25 ✓		37 ✓
		724 ✓	23 ✓	10909 ✓	269 ✓	269 ✓
		701 ✓		10640 ✓		

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PROJECT CHICOPEE FALLS

SUBJECT OAK ST. PUMPING STATION.

PROJECT NO. 6205
 SHEET NO. 5 OF 1
 DATE Feb. 19, 1963
 COMPUTED BY F.N.W.
 CHECKED BY M.A.

I. Cont. Dead Load Only.
 North-South Direction.
 Moments at South Wall.

Mark	Factors	↓	↑	Arm	(M)	SM
S. Wall		44		0.75	33	
do		52		0.81	42	
N. Wall		53		27.17	1440	
do		41		27.34	1120	
Holes		7		27.17		
"		7		27.34	34.5	
N. Intake		64		(24.05)	1540	
do		15		30.67	460	
do		13		30.67	398	
Hole		3		30.67		
N. Intake		16		27.30	(417) 435	92
Hole		2		27.30		
Cover		11		30.67	336	
Hole		1		30.67		
E. Intake		19		9.0	76	
do		25		4.0	100	
Holes		5		4.0		
Cover		3		4.0	12	
Dischge		12		9.25	112	
Gravel		14		7.5	105	
Piers		42.5		10.0	425	
Stop Logs		77		9.25	716	
do		1.5		8.	12	
Intake		3		4	12	
Covers				1.8		
Corrections, p.6.		480		50.6 26 480	7994 597 1397	18 597 B-5

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PROJECT CHICOOEE FALLS

SUBJECT OAK ST. PUMPING STATION

PROJECT NO. 6205
SHEET NO. 6 OF 1
DATE Feb. 19, 1963
COMPUTED BY ENW
CHECKED BY M.A.

I. Cont. Dead Load. North-South Direction
Moments at South Wall.

Mark	Factors	↓	↑	Arm	M)	RM
Roof		13.5 ✓		6.5 ✓	88 ✓	
do		19.8 ✓		19.79 ✓	391 ✓	
Holes			1.3 ✓	9. ✓	12 ✓	
do			1.0 ✓	4. ✓	4 ✓	
do			0.7 ✓	25.5 ✓	20 ✓	
Parapet		28.2 ✓		14. ✓	394 ✓	
Crane		3.5 ✓		19.79 ✓	69 ✓	
Rails						
Pump Rm		40. ✓		19.79 ✓	792 ✓	
Floor						
Holes			1.8 ✓	16. ✓	29 ✓	
do			0.4 ✓	20.5 ✓	8 ✓	
do			1.0 ✓	25. ✓	25 ✓	
do			1.0 ✓	25 ✓	25 ✓	
		105 ✓	7 ✓		1734 ✓	123 ✓
		7 ✓			123 ✓	
		98 ✓			161 ✓	
		712 ✓			1069 ✓	
		481 ✓			6885 ✓	
		1291 ✓			19187 ✓	
CORRECTIONS,						
BASE SLAB. MOM.						
N. INTAKE						
N. INTAKE						
(A)	+ 9 ✓		7.75 ✓		+ 18 ✓	
PUMP RM. FLOOR	- 4 ✓		19.79 ✓		+ 70 ✓	
					- 79 ✓	
					19806 ✓	

B-6

PROJECT CHICOPEE FALLS

SUBJECT OAK ST. PUMPING STATION

PROJECT NO. 6205
SHEET NO. 7 OF
DATE Feb. 20, 1963
COMPUTED BY F.W.
CHECKED BY H.A.

Revised to El. 75.0 See Sheets 7A, 7B & 7C

II. Live Load Only. East-West Direction
Moments at West Wall.

Mark	Factors	\downarrow	\uparrow	Arm	M_{\downarrow}	M_{\uparrow}
Snow	.040 ✓ 20.83×27.75	(19)	23.1	10.5	200	242
Water El. 80.0	.0625 ✓ 7.13.5 ✓ 18	106		10.5	1110	
Discharge chamber	.0625 ✓ 5.5 ✓ 18 ✓ 23.75	147		10.5	9.25	1540
do	.0625 x 4.5 x 3.17 x 17.75 x .3	48		(9.42)	(451)	444
Crane		4		10.5		42
Pumps	3 x 3	9		(9.42)		85
Gear-unit	3 x 1	3		(9.42)		28
Thrust	3 x 3	9		(9.42)		85
Engine	3 x 2	6		9.42		57
WATER IN N. INTAKE	.0625 x 7 x 5.5 x 25.75	351			3598	
WATER IN E.	" .0625 x 8 x 5.5 x 6.75	220		14.12	825	
CORRECTION SNOW & DISCH. CHAMBER		20.827		24.37	510	
		+ 4.1			+ 35	
		439.9			5018	

LIVE LOAD ONLY N-S DIRECTION MOMENTS AT SOUTH WALL						
		\downarrow	\uparrow	Arm	M_{\downarrow}	M_{\uparrow}
Snow		19	14	19.75	266	
Water		106		19.75	2090	
do		147		4.25	624	
do		48		9.25	443	
Crane		4		19.75	79	
Pumps		9		16	144	
Gears		3		16	48	
Thrust		9		16	144	
Exhaust		6		21	126	
WATER IN N. INTAKE		351			3964	
" " E. "		63.6		30.67	1950	
CORRECTION SNOW		20.8		4.50	94	
		4.1		14.00	57	
		439.5			6065	

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PROJECT CHICOPEE FALLS

SUBJECT OAK ST. PUMPING STA.

PROJECT NO. 6205-2

SHEET NO. 74 OF

DATE APR. 1 1963

COMPUTED BY M. A.

CHECKED BY RGD

COMPUTATION FOR DIFFERENCE OF 5'L' (80.0 TO 75.0 FT)
IN WL. IN SUMP BAY AND N. INTAKE BAY.
THIS WILL BE A REDUCTION IN LIVE LOAD.
 $.0625 \times 5 = .313 \text{ k psf}$.
USING FIGURES ON P7 & 8 FOR AREAS AND ARMS.
E-W DIRECTION MOMENTS AT W. WALL.

		\downarrow	\uparrow	ARM.	M_d	M_u
WATER IN SUMP.	$.313 \times 13.5 \times 18$	76.		10.5	798	
N. INTAKE E "	$.313 \times 5.5 \times 25.25$	44.		13.87	610	
E "	$.313 \times 5.5 \times 6.75$	12		2437	292	
		132			1700.	

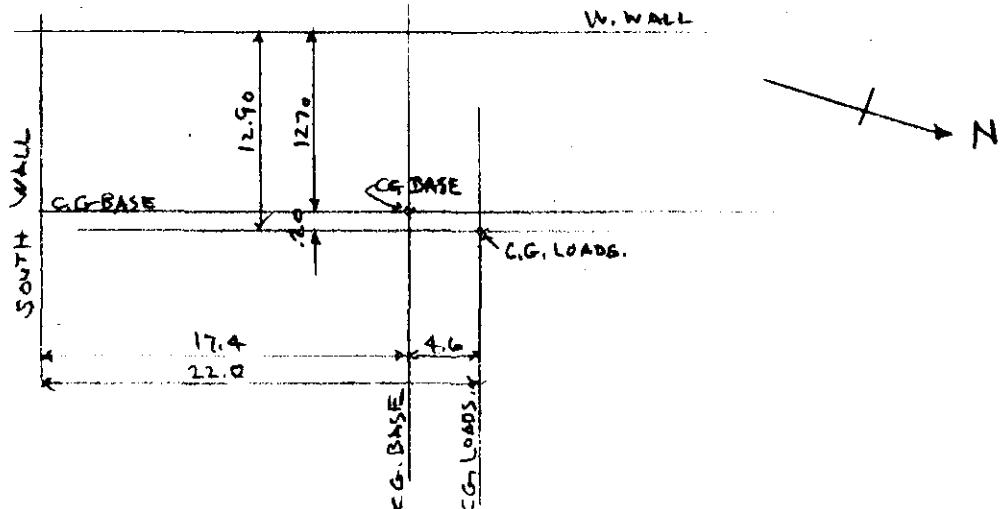
N-S DIRECTION MOMENTS AT SOUTH WALL.

WATER IN SUMP	76	19.75	1300
N. INTAKE	44	30.67	1350
E INTAKE	12	4.50	54
	132		2904

SOIL PRESSURES FROM 5'L' OF WATER ABOVE.

C.G. OF LOADS FROM N-S AXIS. $\frac{1700}{132} = 12.90 \quad \bar{x} = 12.90 - 12.70 = .20$
TOWARD EAST.

C.G. OF LOADS FROM E.W. AXIS. $\frac{2904}{132} = 22.00 \quad \bar{x} = 22.00 - 17.40 = 4.60$
TOWARD NORTH.



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PROJECT CHICOPEE FALLS,

SUBJECT OAK ST. PUMPING STA.

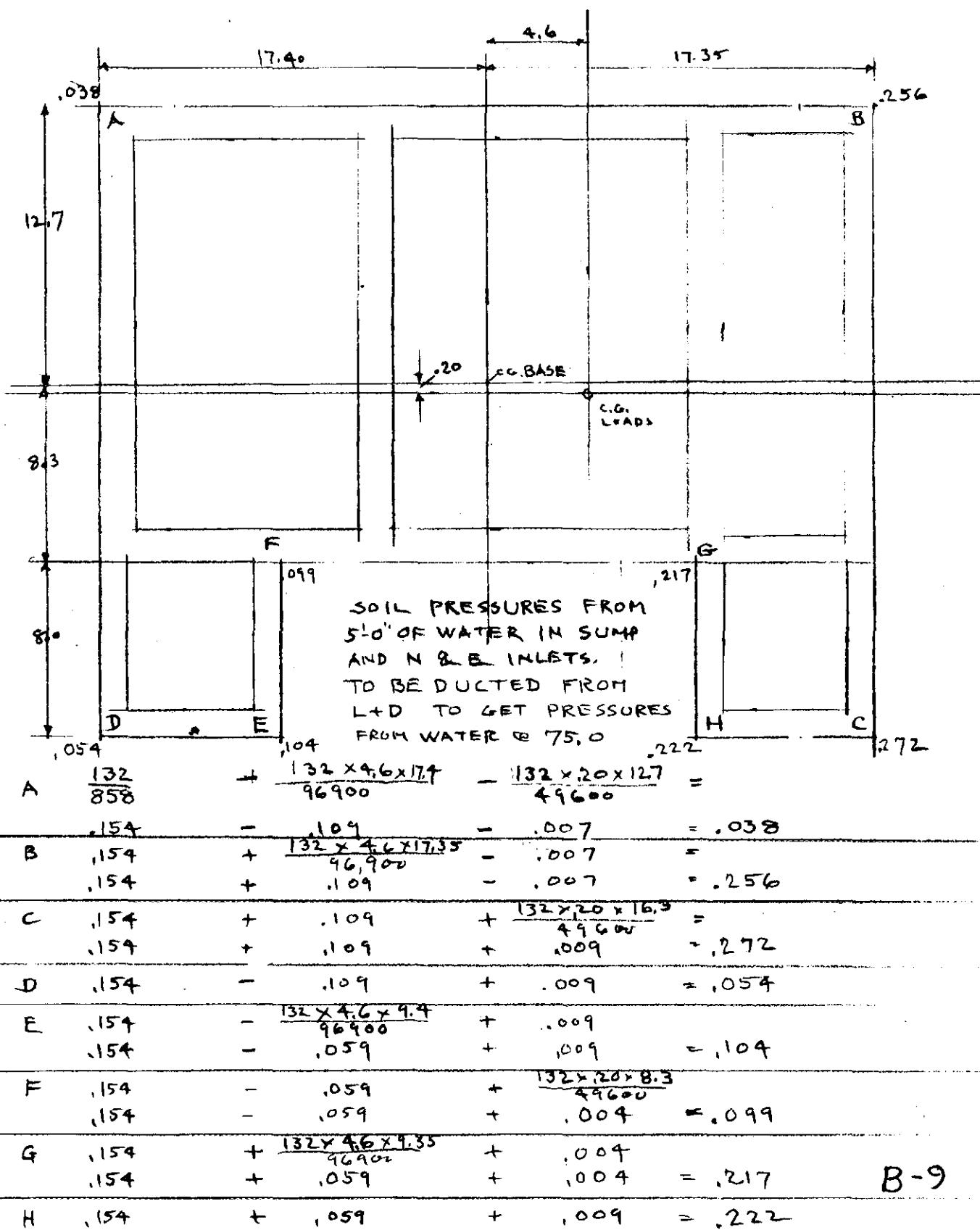
PROJECT NO. 6205-2

SHEET NO. 7B OF

DATE APR. 2, 1963

COMPUTED BY M.A.

CHECKED BY R.P.

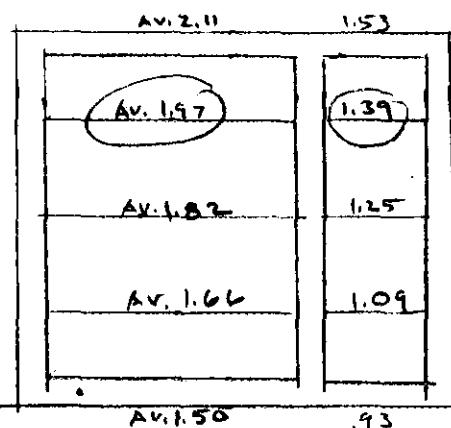
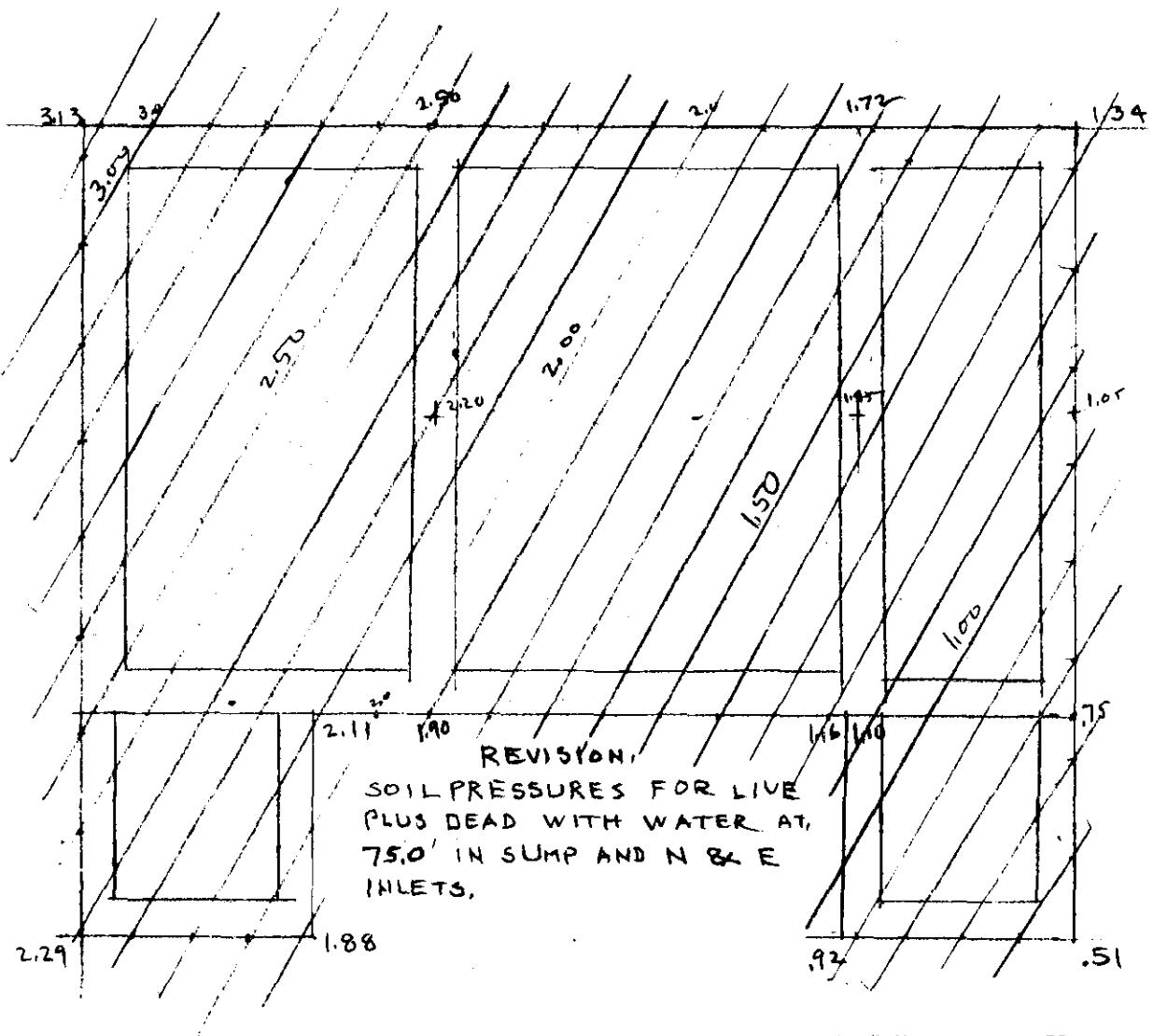


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PROJECT CHICOOPEE FALLS,

SUBJECT OAK ST. PUMPING STA.

PROJECT NO. 6205-2
 SHEET NO. 7C OF 1
 DATE APR. 2, 1963
 COMPUTED BY M.A.
 CHECKED BY RDP



B-10

GREEN ENGINEERING AFFILIATES
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PROJECT CHICOOEE FALLS

SUBJECT OAK ST. PUMPING STATION

PROJECT NO. 6205-2

sheet no. 8 of

DATE Feb 20, 1963

COMPUTED BY F.H.W.

CHECKED BY M.A.

C.G. From West Wall

$$\begin{array}{ll} D. & 1296 \quad 15523 \\ L. & 440 \quad 5052 \\ \hline D+L & 1736 \quad 20575 \end{array} \quad \text{Dead } \bar{x} = \frac{15523}{1296} = 11.97$$

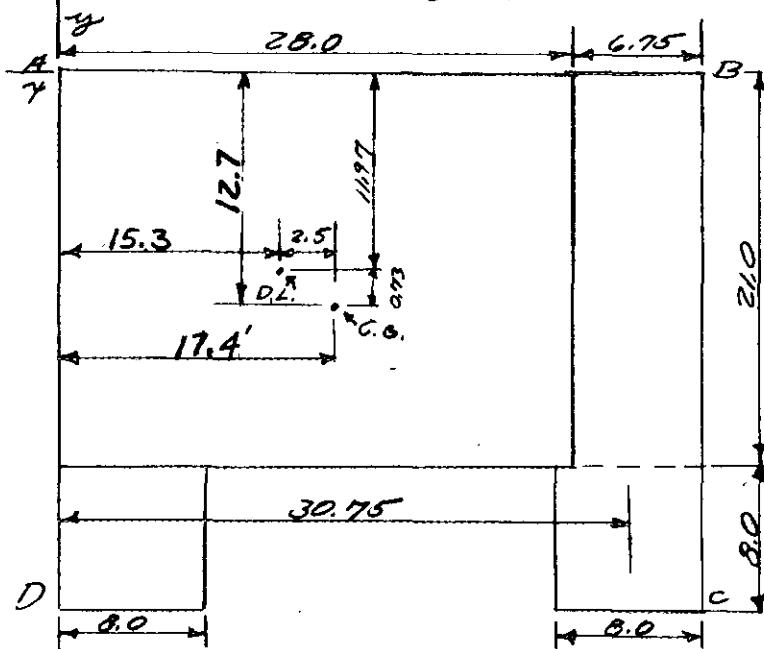
$$D+L \bar{x} = \frac{20575}{1736} = 11.85$$

C.G. From South Wall

$$\begin{array}{ll} D. & 1296 \quad 19806 \\ L. & 440 \quad 6054 \\ \hline D+L & 1736 \quad 25860 \end{array} \quad \text{Dead } \bar{x} = \frac{19806}{1296} = 15.3$$

$$D+L \bar{x} = \frac{25860}{1736} = 14.9$$

C.G. and I of Base



About E-W Axis

$$\begin{aligned} 21 \times 28 &= 588 \times 14 = 8230 \\ 6.75 \times 21 &= 142 \times 31.38 = 4450 \\ 8 \times 8 &= 64 \times 30.75 = 1970 \\ 8 \times 8 &= 64 \times 4 = 256 \\ \hline 858 & \qquad \qquad \qquad 14906 \\ C.G. &= \frac{14906}{858} = 17.4 \end{aligned}$$

About N-S Axis

$$\begin{aligned} 21 \times 28 &= 588 \times 10.5 = 6170 \\ 6.75 \times 21 &= 142 \times 10.5 = 1490 \\ 8 \times 8 \times 2 &= 128 \times 25 = 3200 \\ \hline 858 & \qquad \qquad \qquad 10860 \\ C.G. &= \frac{10860}{858} = 12.7 \end{aligned}$$

I About E-W Axis

$$\begin{array}{lcl} 21 \times \frac{34.75^3}{12} &= 73400 \\ 8 \times \frac{8^3}{12} &= 342 \\ 8 \times \frac{8^2}{12} &= \frac{342}{74084} \\ & & 730 \times 0.2 \\ & & 64 \times 13.35^2 \\ & & 64 \times 13.4^2 \\ & & \hline & & 22850 \\ & & 14084 \\ & & \hline & & 96934 \end{array}$$

I About N-S Axis

$$\begin{array}{lcl} 34.75 \times 21 \frac{1}{12} &= 26700 \\ 2 \times 8 \times 8 \frac{1}{12} &= \frac{684}{27384} \\ & & 588 \times 2.2^2 \\ & & 2 \times 64 \times 12.3^2 \\ & & \hline & & 2840 \\ & & 19360 \\ & & \hline & & 22200 \\ & & 27384 \\ & & \hline & & 49584 \end{array}$$

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GREEN ENGINEERING AFFILIATES
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BOSTON, MASS.

PROJECT CHICOPEE FALLS

SUBJECT OAK ST. PUMPING STA.

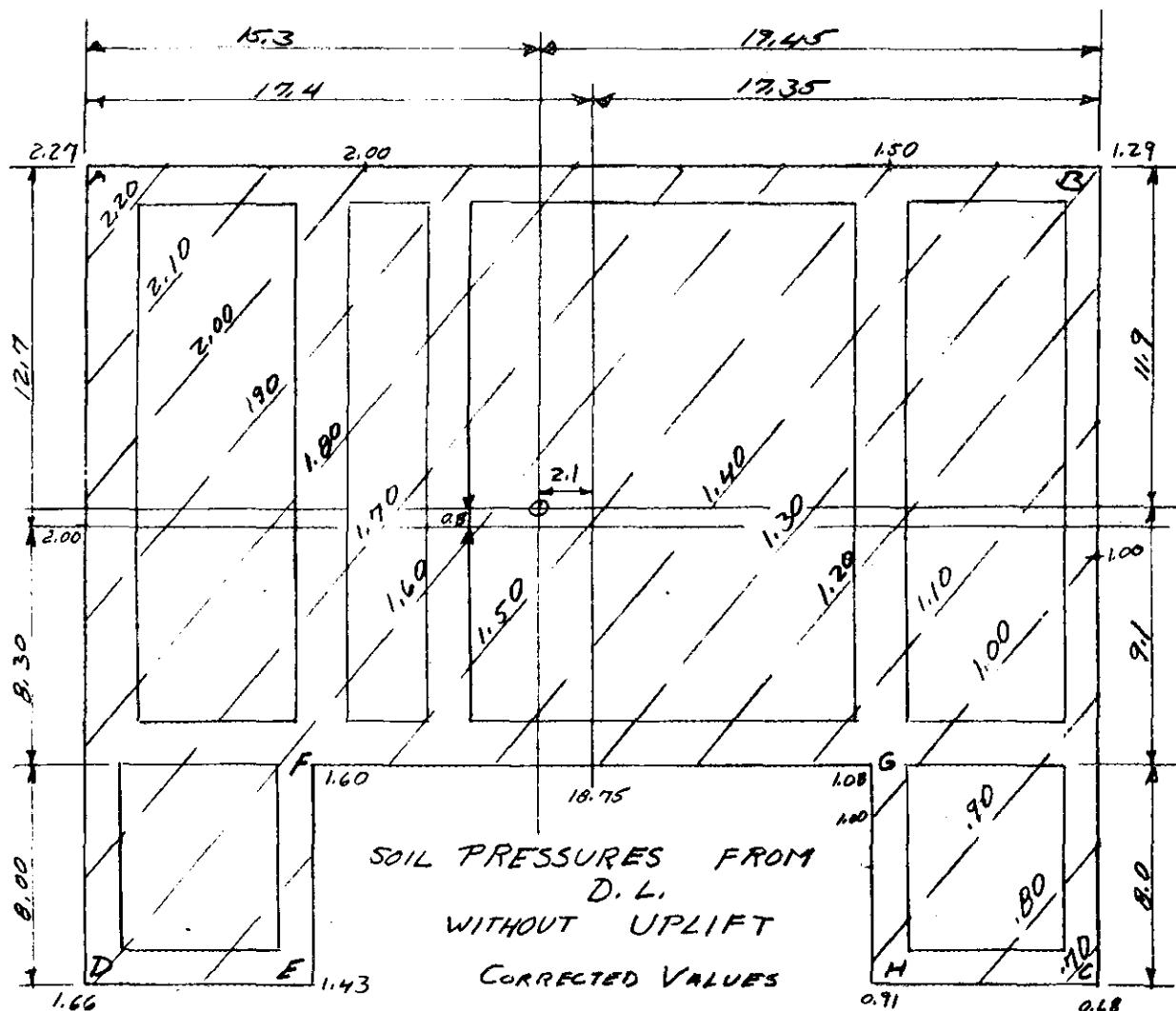
PROJECT NO. 6205-2

SHEET NO. 8A OF 1

DATE Mar. 1, 1963

COMPUTED BY M.A.

CHECKED BY F.H.W.



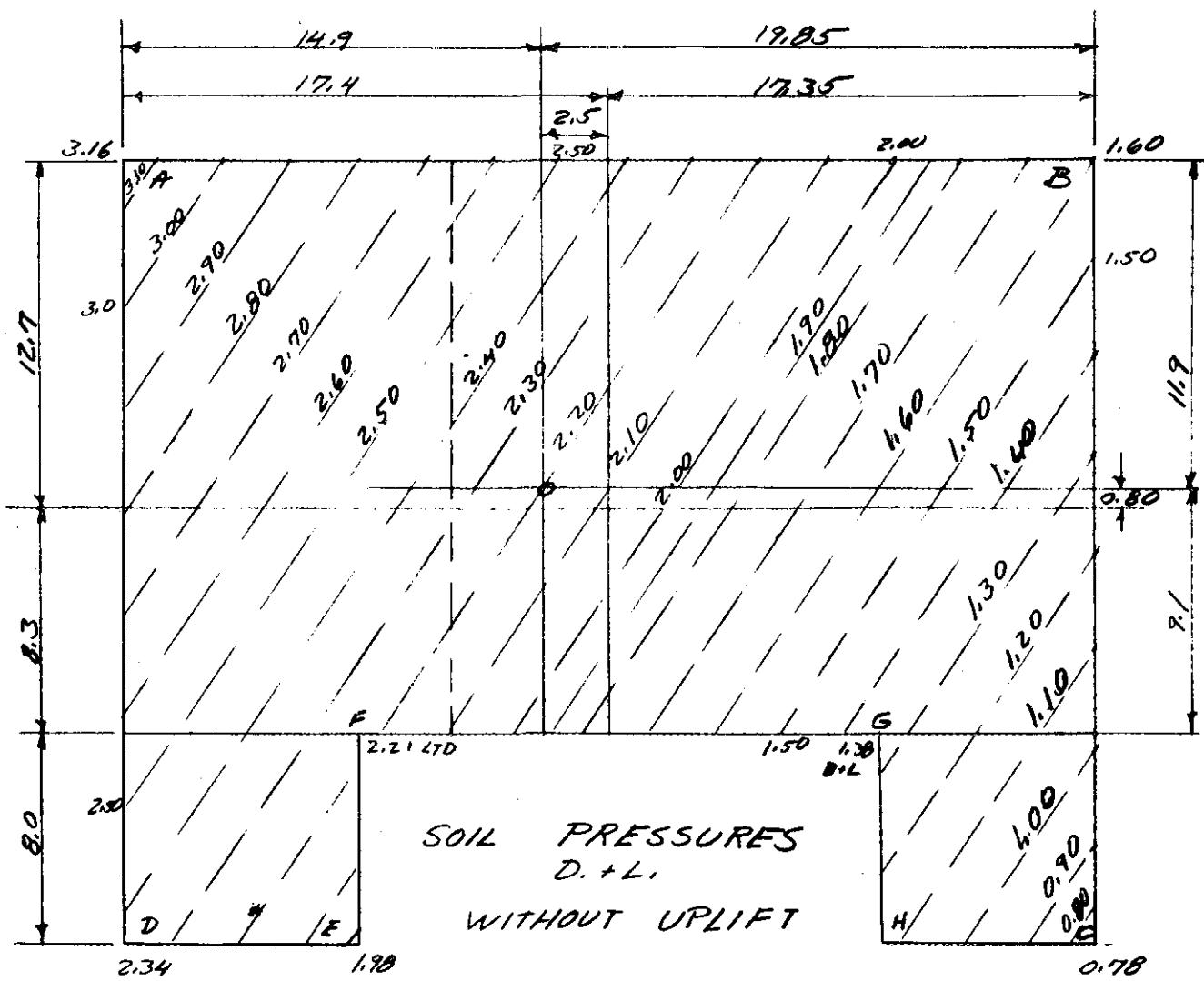
A. 1.51	$\frac{1296 \times 2.1 \times 17.4}{96934}$	$\frac{+ 1296 \times .80 \times 12.7}{49584}$	= 2.27
B. 1.51	$\frac{- 1296 \times 2.1 \times 17.35}{96934}$	$\frac{+ 0.27}{(0.49)}$	= 1.29
C. 1.51	$- 0.49$	$\frac{- 1296 \times 0.8 \times 16.3}{49584}$	= 0.68
D. 1.51	+ 0.49	$- 0.34$	= 1.66
E. 1.51	$\frac{+ 1296 \times 2.1 \times 9.4}{96934}$	$- 0.34$	= 1.43
F. 1.51	$\frac{(0.26)}{+ 0.26}$	$\frac{- 1296 \times 0.8 \times 10.3}{49584}$	= 1.60
G. 1.51	$\frac{- 1296 \times 2.1 \times 9.35}{96934}$	$- 0.17$	= 1.08
H. 1.51	$- 0.26$	$- 0.34$	= 0.91
			B-12

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PROJECT CHICORP FALLS

SUBJECT OAK ST PUMPING STATION

PROJECT NO. 6205
 SHEET NO. 8B OF 1
 DATE 3/1/63
 COMPUTED BY MA
 CHECKED BY POP



A.	<u>1736</u> <u>858</u> (2.02)	+ <u>$\frac{1736 \times 2.5 \times 17.4}{96934}$</u> <u>(0.78)</u>	+ <u>$\frac{1736 \times 0.8 \times 12.7}{49584}$</u> <u>(0.36)</u>	= <u>3.16</u>
B.	2.02	- <u>$\frac{1736 \times 2.5 \times 17.35}{96934}$</u> <u>(0.78)</u>	+ 0.36	= 1.60
C.	2.02	- 0.78	- <u>$\frac{1736 \times 0.8 \times 6.3}{49584}$</u> <u>(0.46)</u>	= 0.78
D.	2.02	+ 0.78	- 0.46	= 2.34
E.	2.02	+ <u>$\frac{1736 \times 2.5 \times 9.4}{96934}$</u> <u>(0.42)</u>	- 0.46	= 1.98
F.	2.02	+ 0.42	- <u>$\frac{1736 \times 0.8 \times 3.3}{49584}$</u> <u>(0.22)</u>	= 2.21
G.	2.02	- <u>$\frac{1736 \times 2.5 \times 9.35}{96934}$</u> <u>(0.42)</u>	- 0.22	= 1.38
H.	2.02	- 0.42	- 0.46	= 1.14

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PROJECT MASS. CHICOPPEE FALLS

SUBJECT OAK ST. PUMPING STA.

PROJECT NO. 62-05-2

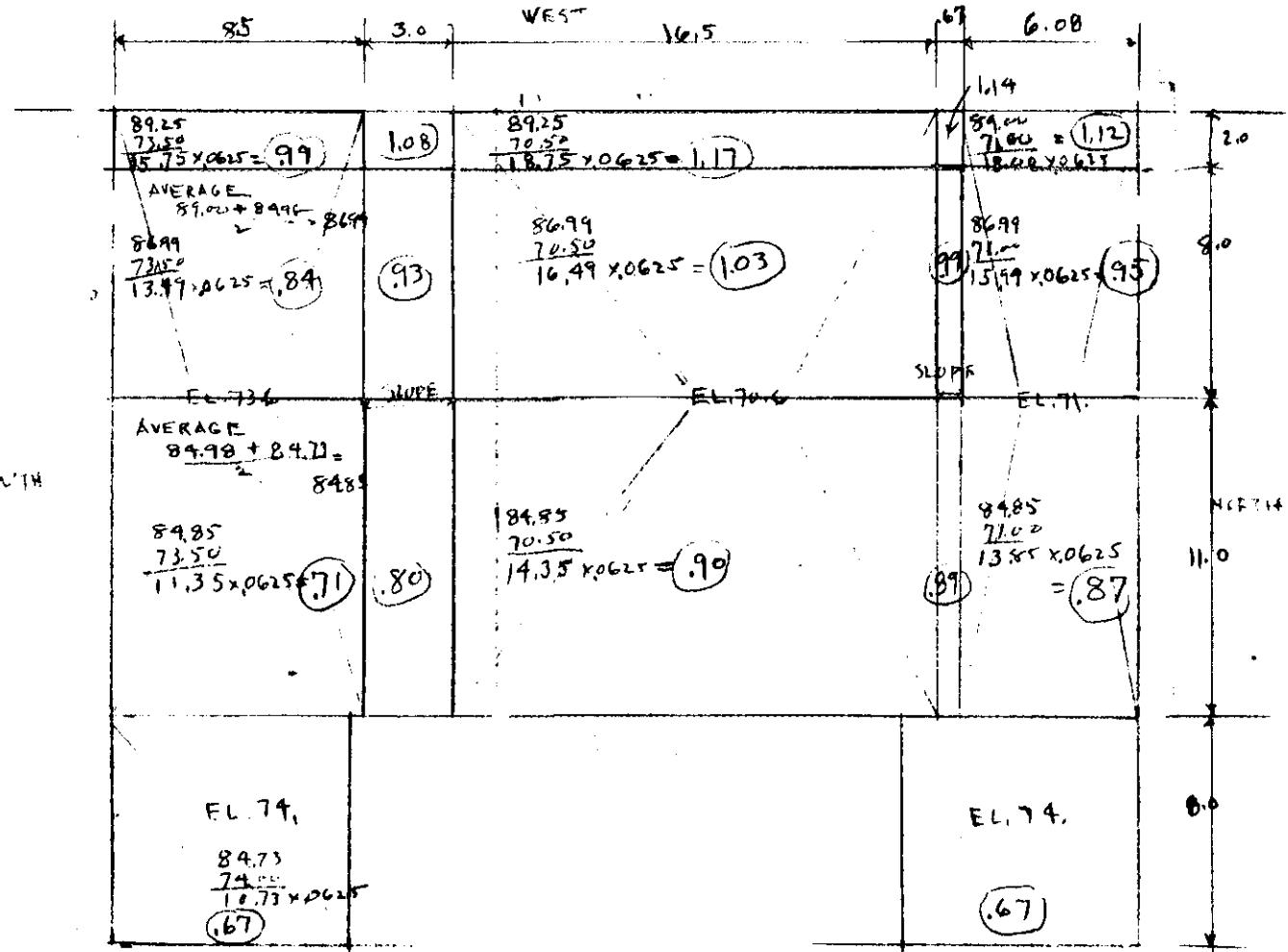
SHEET NO. 9E OF

DATE MAR. 2, 1963

COMPUTED BY M.A.

CHECKED BY F.N.W.

UPLIFT RIVER SIDE



LAST.

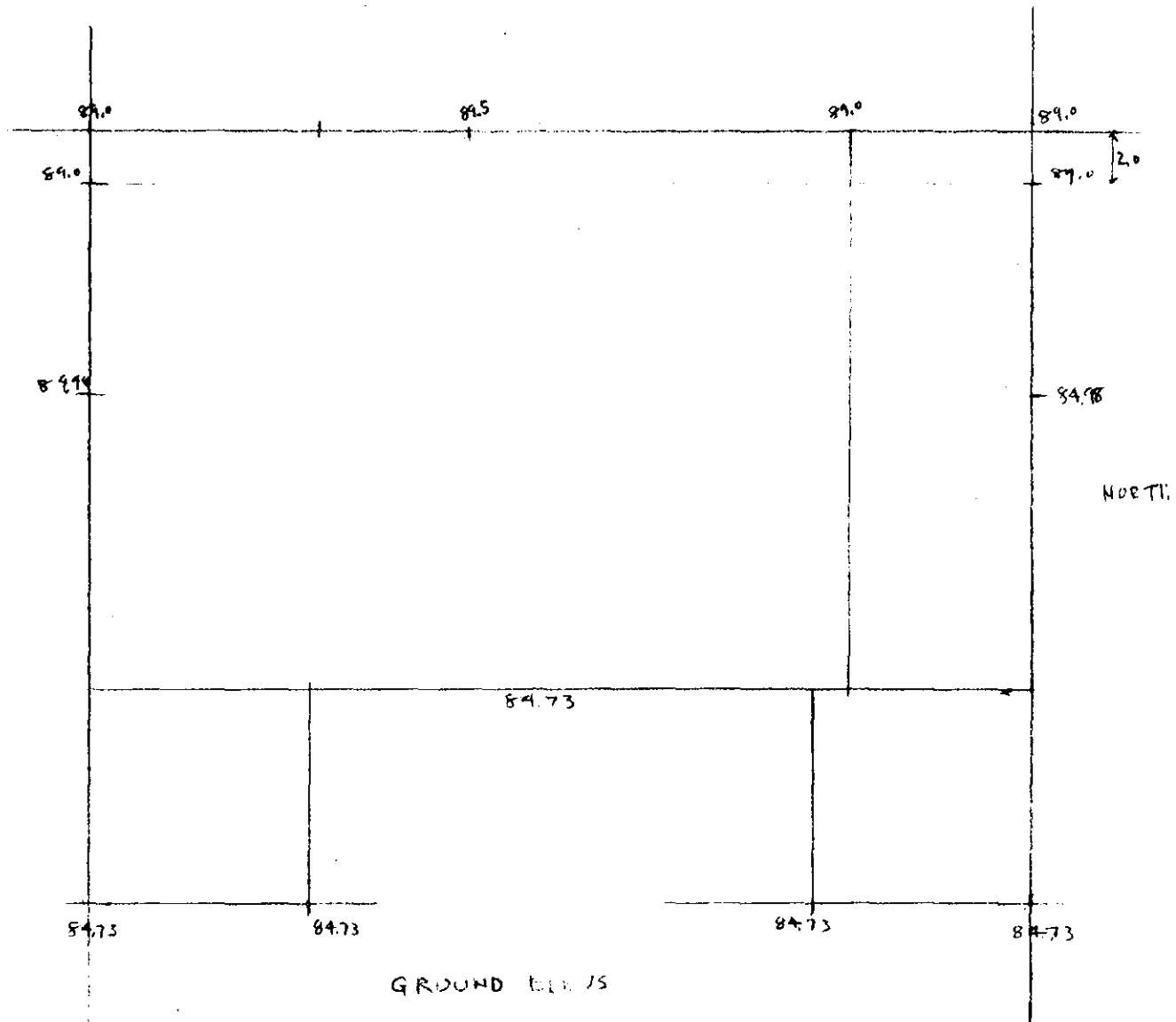
B-14

GREEN ENGINEERING AFFILIATES
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PROJECT MASS. CHICOPEE FALLS,

SUBJECT OAK ST. PUMPING STA.

PROJECT NO. 6205-2
SHEET NO. 9F OF 1
DATE MAR. 2 1963
COMPUTED BY M.A.
CHECKED BY PNW



B-15

GREEN ENGINEERING AFFILIATES
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PROJECT MASS. CHICOPEE FALLS

SUBJECT OAK ST. PUMPING STA

UPLIFT MOMENTS AT WEST WALL

PROJECT NO. 6205-2

SHEET NO. 9C71 OF

DATE MAR. 3, 1963

COMPUTED BY M.A.

CHECKED BY F.N.W.

	UPLIFT	ARM	FM
$.99 \times 8.5 \times 2 =$	16.8		
$1.08 \times 3 \times 2 =$	6.5		
$1.17 \times 16.5 \times 2 =$	38.6	{ 1.00	
$1.14 \times .67 \times 2 =$	1.5		
$1.12 \times 6.08 \times 2 =$	13.6		
$.84 \times 8.5 \times 8 =$	77.0		
$.93 \times 3 \times 8 =$	57.2		
$1.03 \times 16.5 \times 8 =$	22.3		
$.99 \times .67 \times 8 =$	135.7	{ 6.00	
$.95 \times 6.08 \times 8 =$	51.3		
	46.2		
	266.7		1600.
$.71 \times 8.5 \times 11 =$	66.4		
$.80 \times 3 \times 11 =$	26.4		
$.96 \times 16.5 \times 11 =$	163.5	{ 15.5	
$.89 \times .67 \times 11 =$	6.5		
$.87 \times 6.08 \times 11 =$	58.0		
	329.8		4980.
$.74 \times 8 \times 8 \times 2$	94.7	25.	2370
Σ UPLIFT	759.2		9027
CENTROID FROM WEST WALL			
$\frac{9027}{759.2} = 11.90$			

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GREEN ENGINEERING AFFILIATES
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PROJECT MASS. CHICOPEE FALLS.

SUBJECT OAK ST. PUMPING STA.

UPLIFT MOMENTS AT SOUTH WALL

PROJECT NO. 6205-2
 SHEET NO. 9H OF 1
 DATE MAR 2, 1963
 COMPUTED BY M.A.
 CHECKED BY F.N.W.

	UPLIFT.	ARM.	F_M
.99 x 8.5 x 2 .84 x 8.5 x 8 .71 x 8.5 x 11	14.8 57.2 66.4	} 4.25	
	140.4		597.
1.08 x 3 x 2 .93 x 3 x 8 .80 x 3 x 11	6.5 22.3 26.4	} 10	
	55.2		552.
1.17 x 16.5 x 2 1.03 x 16.5 x 8 9.0 x 16.5 x 11	38.6 135.7 163.5	} 19.75	
	337.8		6660.
1.14 x 6.7 x 2 .99 x 6.7 x 8 .89 x 6.7 x 11	1.5 5.3 6.5	} 28.33	
	13.3		376.
1.12 x 6.08 x 2 .95 x 6.08 x 8 .87 x 6.08 x 11	13.6 46.2 58.0	} 31.71	
	117.8		3730
.74 x 8 x 8 x 2	99.7	17.37	1643
	Σ UPLIFT.	759.2	13,558.
CENTROID FROM SOUTH WALL			
	$\frac{13558}{759.2} = 17.85$		

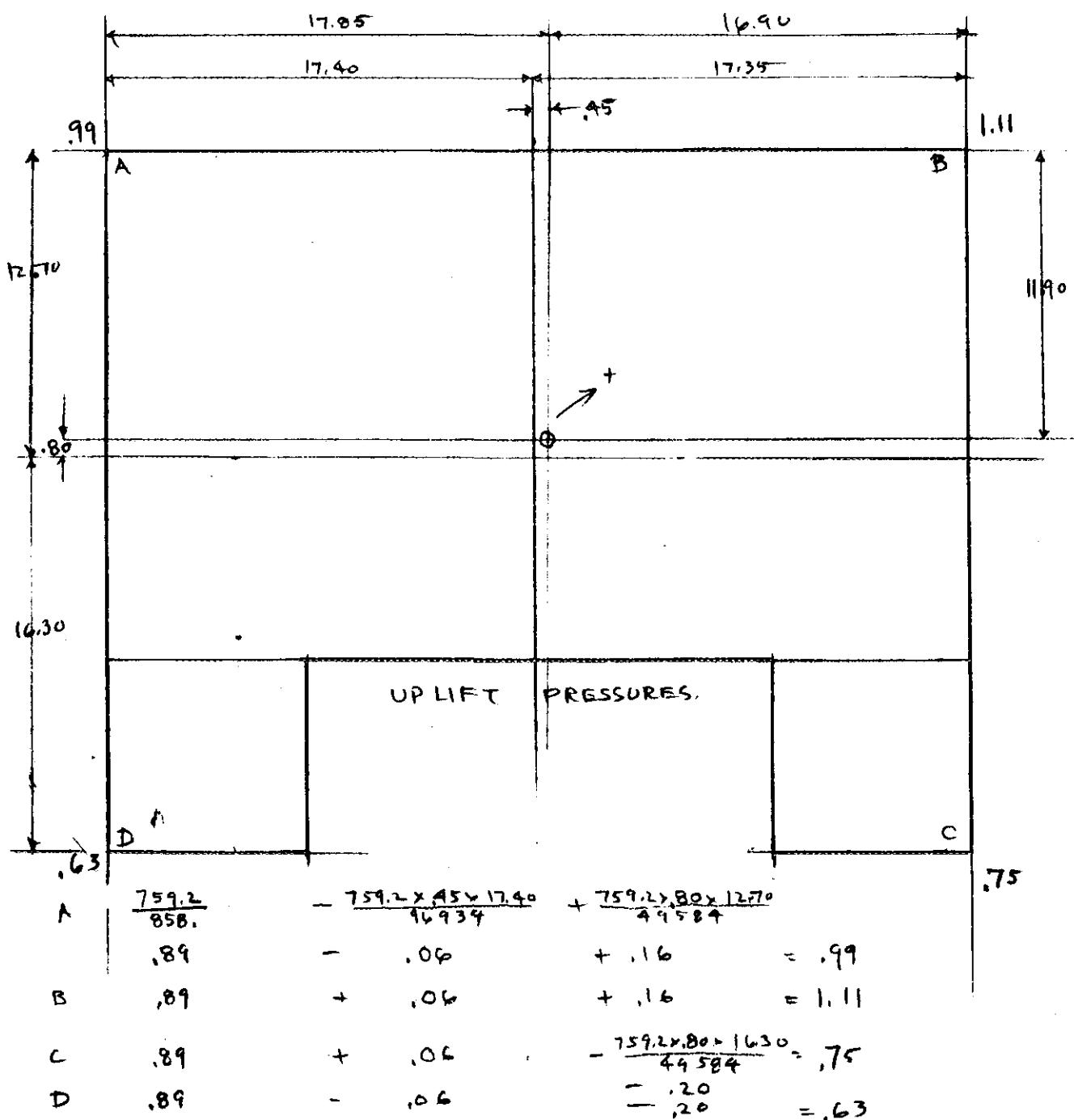
B-17

GREEN ENGINEERING AFFILIATES
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PROJECT MASS. CHICOPPEE FALLS

SUBJECT OAK ST. PUMPING STA.

PROJECT NO. 6205-2
 SHEET NO. 9 I OF
 DATE MAR. 2 1963
 COMPUTED BY M.A.
 CHECKED BY F.N.W.



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GREEN ENGINEERING AFFILIATES
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PROJECT CHIKOPEE LOCATION

SUBJECT OAK ST. PUMPING STATION

PROJECT NO. 6205-2

SHEET NO. 10A OF

DATE MAR. 4, 1963

COMPUTED BY MA

CHECKED BY E.C.W.

10 REVISED

PRESSURE TAKEN = 3.16 WAS FOR DEAD PLUS LIVE
 $\frac{5/26}{2.79} = \frac{0.37}{}$

(1)

Water .0625 x 23.75

1.48

1.31

We should also take out
Water in discharge chamber
Net Uplift per 4' 6'-0" span

The 5'-0" span should have uplift reduced by
weight of gravel fill

$2.05 - 0.37 = 2.48$
Gravel 0.135 x 5

.68

1.80 Net uplift

1.31	1.80	FEM $\frac{1}{12} \times 1.31 \times 6^2 = 3.93$
		FEM $\frac{1}{12} \times 1.80 \times 5^2 = 3.75$

For D+L

(2)

On the other hand using Dead Load

Corrected Value $M_{D+L} = 2.27$

$\frac{5/26}{2.27} = \frac{0.37}{}$

1.90

Net 6'-0" span

For 5'-0" span $2.05 - 0.37 = 1.68$

Take out gravel .68

1.00

1.90	1.00	FEM $\frac{1}{12} \times 1.90 \times 6^2 = 5.70$
		$\frac{1}{12} \times 1.00 \times 5^2 = 2.08$

D+L

	+3.93	-3.93	+3.75
	+1.13	+1.15	
	-3.80	+3.90	+0.07
M	+0.06		
	+3.99		-3.68
R	3.94	3.94	4.50
	+0.03	-0.03	4.50
	+3.97	3.97	4.74
		8.65	4.26

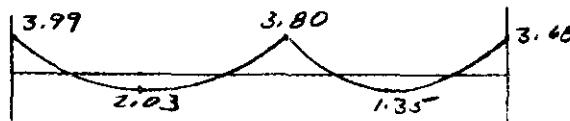
$$0\text{shear } \frac{3.97 - 3.03}{1.31} = 3.03$$

$$\frac{4.26}{1.80} = 2.36$$

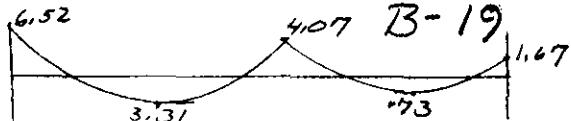
$$\text{Span M } \frac{3.97 \times 3.03}{2} = 6.02$$

$$F_{ndM} \frac{8.99}{2} = 2.03$$

$$S_{D+L} M \frac{8.99}{2} = 2.03$$



	+5.70	-5.70	+2.08
	+1.63	+1.99	
	-4.07	+4.07	+1.00
	+6.52		-1.08
	5.70	5.70	2.50
	+1.41	-0.41	-0.60
	6.11	5.29	3.10
			1.70
		8.39	
	$\frac{6.11}{1.90} = 3.22$	$\frac{1.90}{1.00} = 1.90$	
	$\frac{6.11 \times 3.22}{2} = 9.83$	$\frac{1.90 \times 1.90}{2} = 1.81$	
	$\frac{6.52}{3.31} = 1.98$	$\frac{1.08}{1.73} = 0.62$	



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PROJECT CHICOPEE FALLS
SUBJECT OAK ST. PUMPING STATION

PROJECT NO. 6205-2
SHEET NO. 103 OF _____
DATE MAR. 4, 1963
COMPUTED BY M.A.P.
CHECKED BY E.I.Y.W.

REVISED DESIGN FLOOR - DISCHARGE CHANNEL

Max Pos M. (Bottom steel) 6.52

$$\frac{M}{K} = \frac{6.52^2}{160} = 0.040 \quad \text{Min d-6\frac{1}{2} we have } 25\frac{1}{2}$$

$$A_s = \frac{6.52}{1.44 \times 25\frac{1}{2}} = 0.18 \quad \# 5 @ 18 = 0.21$$

Max neg. M. 3.21 (top steel)

$$A_s = \frac{3.31}{1.44 \times 26\frac{1}{2}} = 0.087 \quad \# 5 @ 18 = 0.21$$

$$\text{Min Steel } 0.001 \times 12 \times 25\frac{1}{2} = 0.31 \quad \# 5 @ 12 = 0.31$$

$$\text{Max. } v = \frac{6110}{12 \times 7 \times 25\frac{1}{2}} = 23 < 90$$

$$w = \frac{6110}{2 \times 7 \times 25\frac{1}{2}} = 137 < 300$$

5 @ 12 TAB will be O.K.

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PROJECT CHICOOEE FALLS,

SUBJECT OAK ST. PUMPING STA.

PROJECT NO. 6205-2

SHEET NO. 12A OF

DATE APR. 2, 1963

COMPUTED BY M.A.

CHECKED BY P.B.

REVISION OF DESIGN FOR FLOOR OF SUMP AND
N. INLET, WITH WATER AT 75.0
LOADS.

SumP - DEAD 1.23 K.S.F. NET UP }
INLET - DEAD .99 " " " } AS BEFORE

$$\text{SumP P+L. } 1.97 - .37 = 24.0625 \text{ = 1.48 NET UP}$$

$$\text{INLET. } 1.39 - .30 = 24.0625 = .97$$

IT WOULD SEEM THAT A LOAD OF 1.50 IN THE SUMP
COMBINED WITH A LOAD OF 1.00 IN INLET WOULD BE OK.

$$\frac{1}{2} \times 1.50 \times 14.17^2 = 25.0 \quad \frac{1}{2} \times 1.00 \times 6.88^2 = 3.4$$

.49 .51

	+25.00	-25.00	+3.94	-3.94
	+ 5.16	+ 10.32	+10.74	+ 5.37
M.	+30.16	-14.68	+14.68	+1.43
R.	10.63	10.63	3.44	3.44
	+1.09	- 1.09	+2.34	- 2.34
	11.72	9.54	5.78	1.10

$$\text{ZERO SHEAR. } \frac{11.72}{1.50} = 7.80$$

$$\text{SPAN M. } 11.72 \times \frac{7.80}{2} = 45.8$$

END M.

30.2

15.6

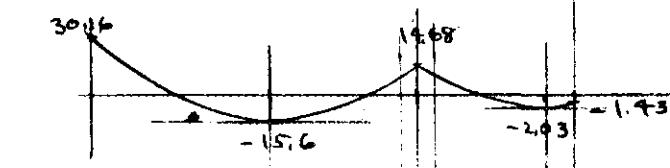
$$\text{ZERO SHEAR. } \frac{1.10}{1.0} = 1.10$$

$$\text{SPAN M. } 1.10 \times \frac{1.10}{2} = .60$$

END M.

1.43

2.03



$$U = \frac{11.720}{12 \times \frac{7}{8} \times 25^{\frac{1}{2}}_2} = 44 < 90^\circ$$

$$U = \frac{11.720}{12 \times \frac{7}{8} \times 19^{\frac{1}{2}}_2} = 28$$

$$U = \frac{11.720}{3.5 \times \frac{7}{8} \times 25^{\frac{1}{2}}_2} = 150 < 300^\circ$$

$$\text{TOP STEEL } A_s = \frac{15.6}{1.44 \times 26^{\frac{1}{2}}_2} = .4 \text{ in}^2 \quad \#6 @ 12$$

$$U = \frac{11.720}{2.8 \times \frac{7}{8} \times 19^{\frac{1}{2}}_2} = 121.$$

$$A_s = \frac{2.03}{1.44 \times 20^{\frac{1}{2}}_2} = .07 \text{ in}^2 \quad \#4 @ 12$$

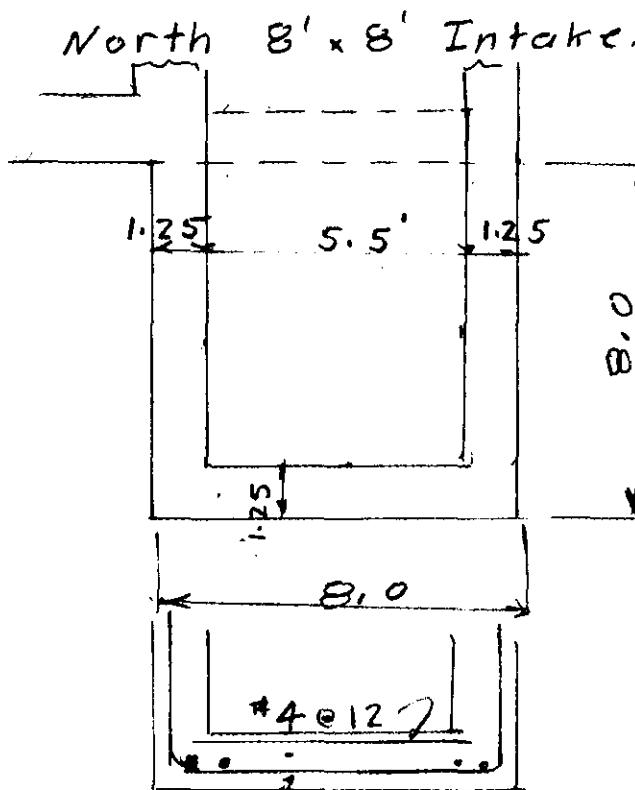
BOTTOM STEEL

$$\text{LEFT, } \frac{30.16}{1.44 \times 25^{\frac{1}{2}}_2} = .82 \text{ in}^2 \quad \#9 @ 12$$

PROJECT CHICOPEE FALLS

SUBJECT OAK ST. PUMPING STATION

PROJECT NO. 6205
SHEET NO. 14 OF
DATE Feb. 21, 1963
COMPUTED BY F.W.
CHECKED BY M.A.

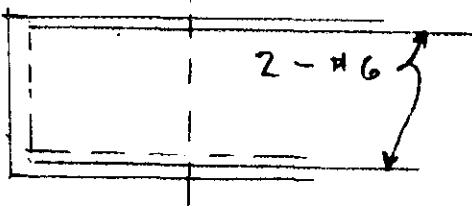


$$P_{11} \text{ pressure} = 0.90 \\ 0.88 \\ w = 3.34 \frac{1}{2} = 1.67 \quad 0.63 \\ .15 \cdot 2 \quad .30 \quad 0.93 \\ \underline{21.37}$$

$$M = 1.37 \times 6.75 = 6.24$$

$$A_s = \frac{6.24}{1.44 \cdot 19.5} = 0.22 \\ \#5 @ 12 = 0.3 \quad \text{Both ways}$$

side Walls as Cantilevers



#5 @ 12

Approx. Load.

REINF. IN CANTILEVER WALLS.

$$A_s = \frac{32.2}{1.44 \cdot 150} =$$

$$A_s = 0.149$$

$$1.37 \times 8 \times 8 = 87.5$$

$$\text{Walls. } 0.15 \cdot 13 \cdot 1.25 \cdot 8 \cdot 2 = 39$$

$$\text{" } 0.15 \cdot 13 \cdot 1.25 \cdot 5.5 \cdot 13.5$$

$$\text{Cover } 0.15 \cdot 0.5 \cdot 5.5 \cdot 6.75 \cdot 2.8$$

$$\text{CANT. H.O.M. } \underline{\underline{55.3}} \\ 32.2$$

Run two #6 top + bot. along walls.

South 8 x 8' Intake.

$$\text{PRESSURE} = 3.10 - 0.30 = 2.80$$

$$M = 2.8 \times 6.75^2 = 12.75$$

$$A_s = \frac{12.75}{1.44 \cdot 19.5} = 0.455$$

= 0.23" for 2-way steel.

Use #5 @ 12 both ways.

#4 @ 12 top

B-22

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PROJECT MASS. CHICOPPEE FALLS.

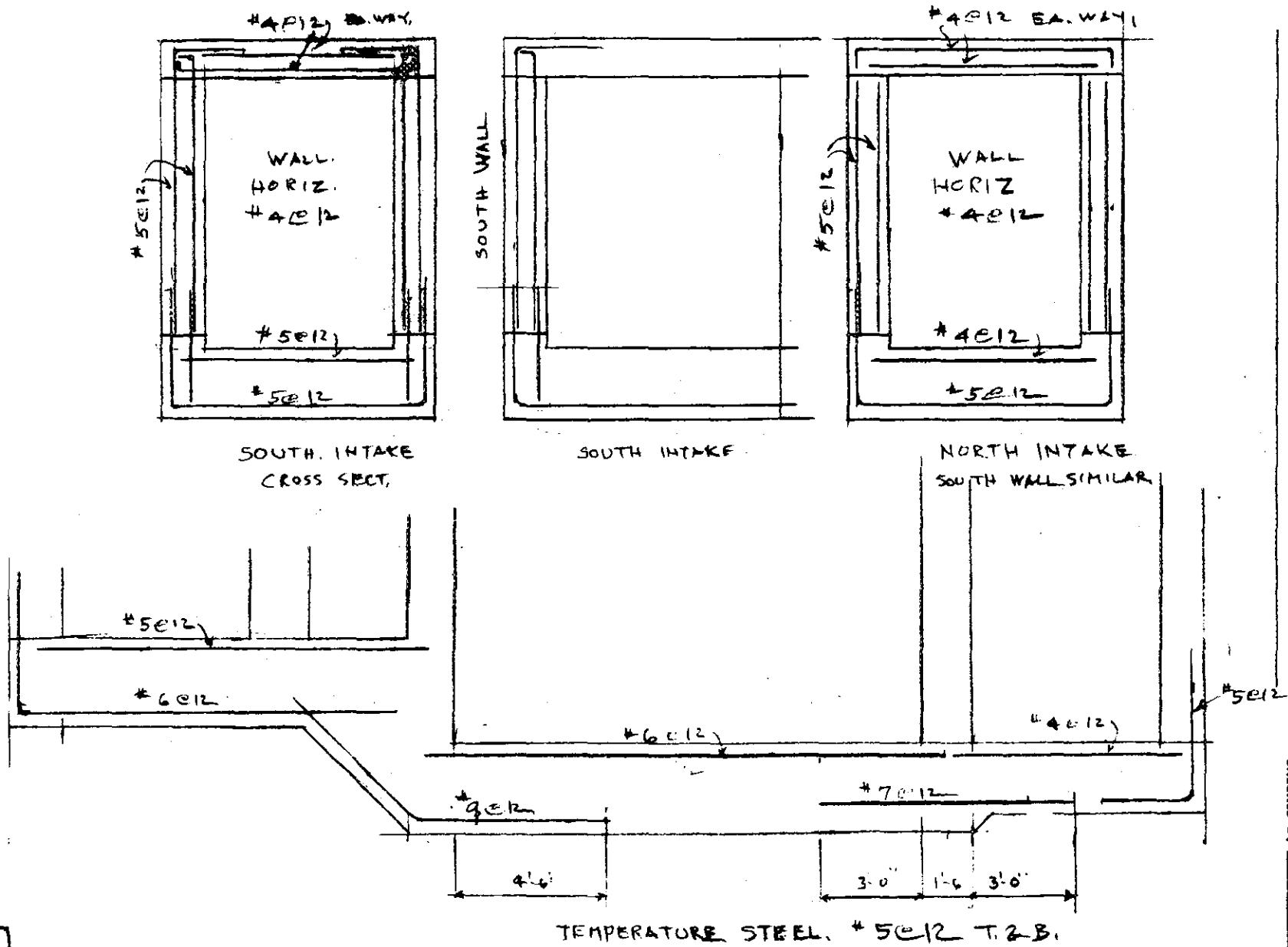
SUBJECT OAK ST. PUMPING STA.

PROJECT NO. 6205-2

sheet no. 14A or

DATE MAR. 4, 1963

COMPUTED BY M.A. F.M.W.



B-23

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PROJECT MASS. CHICOPPEE FALLS.

SUBJECT OAK ST. PUMPING STA.

PROJECT NO. 6205-2
SHEET NO. 14 B OF
DATE MAR. 5, 1963
COMPUTED BY M.A.
CHECKED BY F.N.W.

BURSTING IN SOUTH INTAKE
AT CORNER. HOR. STEEL. $M_y = .025 \times .284 \times \frac{5.50^3}{12} = 11.6$
VERT. STEEL. $A_s = \frac{1.18}{1.44 \times 11\frac{1}{2}} = .071$
SEE BULLETIN ST 63
PORTLAND CEM. ASSOC.

$$M_x = .005 \times .284 \times \frac{5.50^2}{12} = .235$$

$$A_s = \frac{.235}{1.44 \times 11\frac{1}{2}} = .014$$

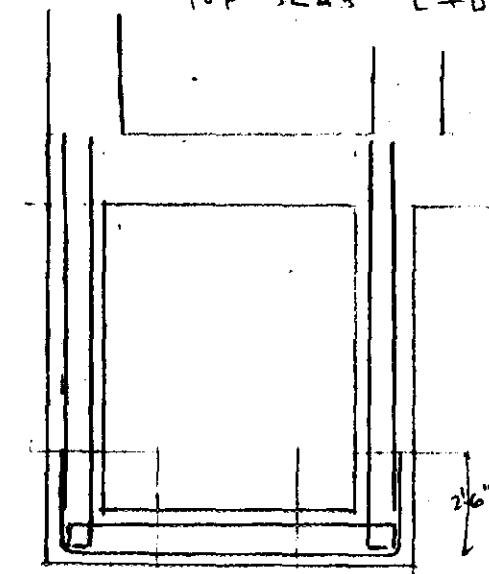
AT MIDDLE HOR. $M_y = .011 \times .284 \times \frac{5.50^3}{12} = .52$
 $A_s = \frac{.52}{1.44 \times 11\frac{1}{2}} = .031$
VERT. $M_x = .009 \times .284 \times \frac{5.50^2}{12} = .43$
 $A_s = \frac{.43}{1.44 \times 11\frac{1}{2}} = .026$

FOR 1'3 WALL
TEMP. STEEL .001 \times 12 \times $11\frac{1}{2}$ = 1.38 M.I.H.

USE #4@12 HOR. = .20
#5@12 VERT. = .31

THE TOP SLAB HAS AN UP LOAD OF 1.00
12" SLAB $\frac{.15}{.85}$
2 WAY. $M = .05 \times .85 \times 6.75 = 1.94$
 $A_s = \frac{1.94}{1.44 \times 8\frac{1}{2}} = .158 \quad \#4@12 = .20$

TOP SLAB L+D. DOWN. $L = 1.20m$
 $D = \frac{.150}{.350}$ #4@12 EA WAY.



HORIZ. SECT.
SOUTH INTAKE

HORIZ. SECT.
N. INTAKE

B-24

PROJECT CHICOPEE FALLS

SUBJECT OAK ST. PUMPING STATION

DESIGN OF WALLS

1. As ring at El. 770

Due to submerged earth pressure. No water inside the structure

Saturated earth pressure @ 135 #/ft. $135 - 62.5 = 72.5$

$$\text{Horiz} = 0.0625$$

$$+\frac{1}{3} \times 0.723 = 0.0242$$

$$0.0867 = 0.087 \text{ #/ft.}$$

$$\text{On West Side pres.} = 89.0 - 77.0 = 0.087 \times 12 = 1.05$$

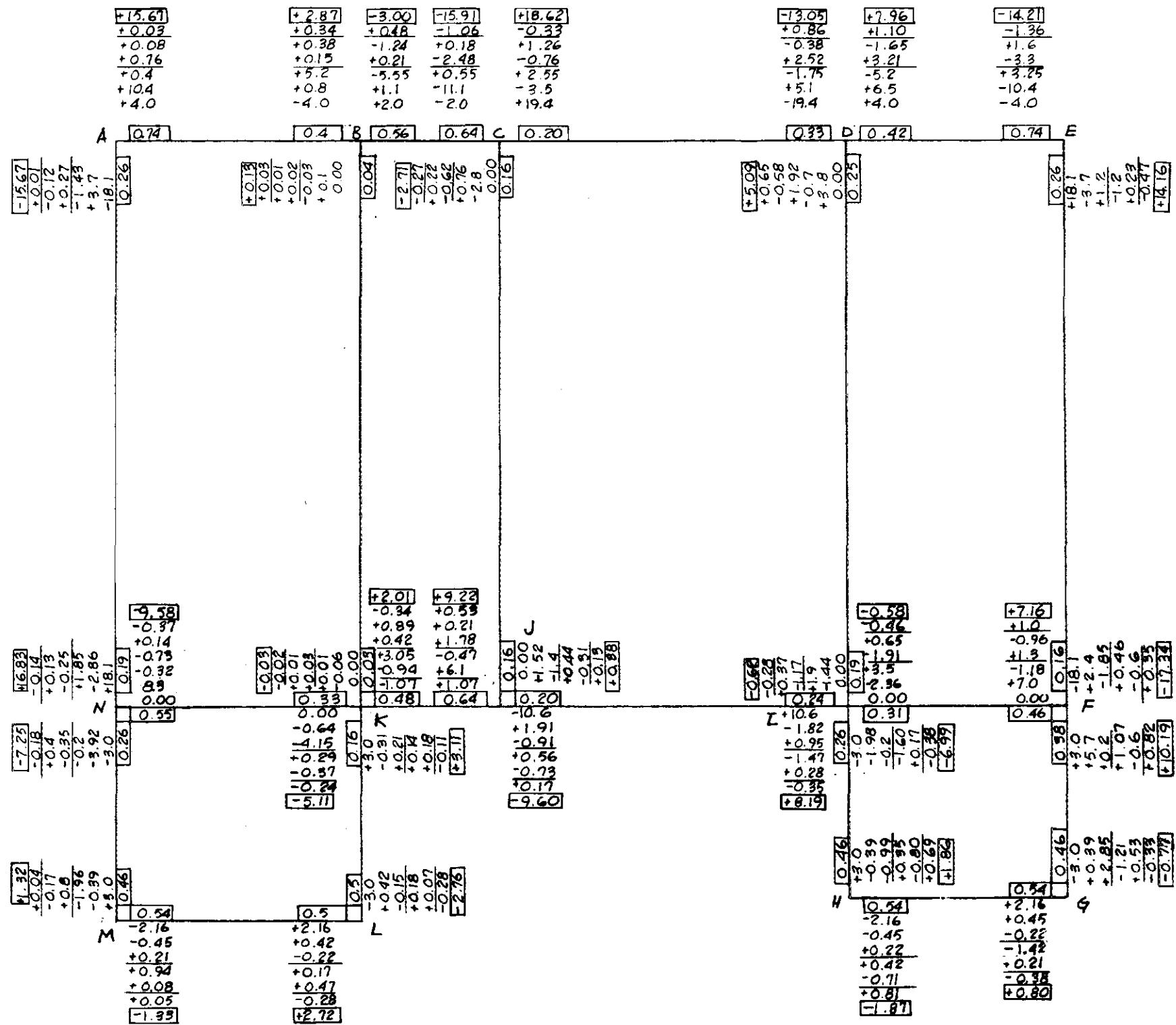
$$\text{On Other Sides } 83.5 - 77.0 = 0.087 \times 6.5 = 0.57$$

$$84.73 - 78.0 = 6.73$$

SPANS

AB	$M = 1.05 \times 6.75^2 / 12 = 4.0$	$I/2 = 1.5^3 / 6.75 = 0.5$
BC	$M = 1.05 \times 4.75^2 / 12 = 2.0$	$I/2 = 1.5^3 / 4.75 = 0.71$
CD	$M = 1.05 \times 14.92^2 / 12 = 19.4$	$I/2 = 1.5^3 / 14.92 = 0.226$
DE	$M = 1.05 \times 6.82^2 / 12 = 4.1$	$I/2 = 1.25^3 / 6.82 = 0.29$
EF	$M = 0.57 \times 19.5^2 / 12 = 18.1$	$I/2 = 1.25^3 / 19.5 = 0.1$
FG	$M = 0.57 \times 8.0^2 / 12 = 3.0$	$I/2 = 1.25^3 / 8.0 = 0.244$
GH	$M = 0.57 \times 6.75^2 / 12 = 2.16$	$I/2 = 1.25^3 / 6.75 = 0.29$
HJ	$M = 0.57 \times 8.0^2 / 12 = 3.0$	$I/2 = 1.25^3 / 8.0 = 0.244$
IJ	$M = 0.57 \times 14.92^2 / 12 = 10.6$	$I/2 = 1.5^3 / 14.92 = 0.226$
JK	$M = 0.57 \times 4.75^2 / 12 = 1.07$	$I/2 = 1.5^3 / 4.75 = 0.71$
KL	$M = 0.57 \times 8.0^2 / 12 = 3.0$	$I/2 = 1.25^3 / 8.0 = 0.244$
LM	$M = 0.57 \times 6.75^2 / 12 = 2.16$	$I/2 = 1.25^3 / 6.75 = 0.29$
MN	$M = 0.57 \times 8.0^2 / 12 = 3.0$	$I/2 = 1.25^3 / 8.0 = 0.244$
HA	$M = 0.57 \times 19.5^2 / 12 = 18.1$	$I/2 = 1.5^3 / 19.5 = 0.174$
CJ	$M = 0.0$	$I/2 = 1.5^3 / 19.5 = 0.174$
BK	$M = 0.0$	$I/2 = 1.0^3 / 19.5 = 0.051$
DI	$M = 0.0$	$I/2 = 1.5^3 / 19.5 = 0.174$
IF	$M = 0.0$	$I/2 = 1.25^3 / 6.75 = 0.29$
NK	$M = 0.0$	$I/2 = 1.5^3 / 6.75 = 0.5$

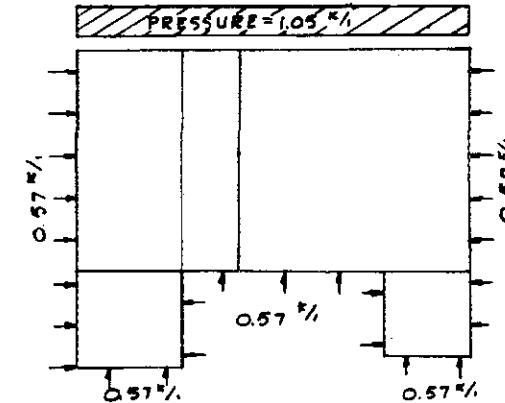
B-25



OAK STREET PUMPING STATION

MOMENT DISTRIBUTION AT ELEVATION 77.0 NO WATER

NO SCALE



LOADING DIAGRAM

B-26

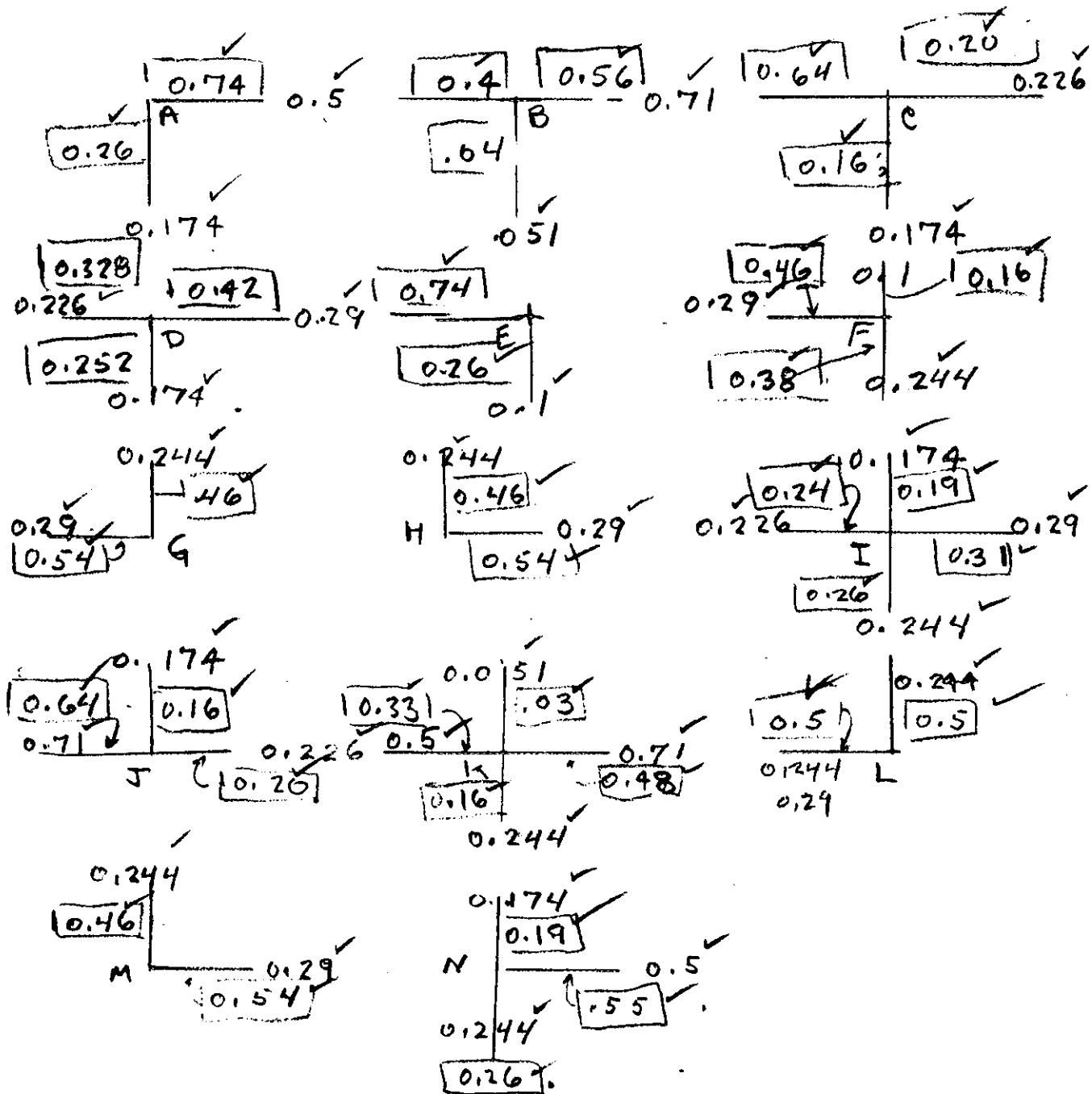
PROJECT CHICOOPEE FALLS

SUBJECT OAK ST. PUMPING STATION

PROJECT NO. 6205
SHEET NO. 16 OF
DATE Feb. 25, 1963
COMPUTED BY F.M.W.
CHECKED BY M.A.

Design of Walls.

1. As Ring at El. 77.0 Inward Pressure.
Distribution and Carry-Over Factors.



GREEN ENGINEERING AFFILIATES
ENGINEERS
BOSTON, MASS.

PROJECT CHICOOPEE FALLS

SUBJECT OAK ST. PUMPING STA.

PROJECT NO. 6205-2
SHEET NO. 17 OF _____
DATE Feb. 27, 1963
COMPUTED BY F.H.W.
CHECKED BY M.B.

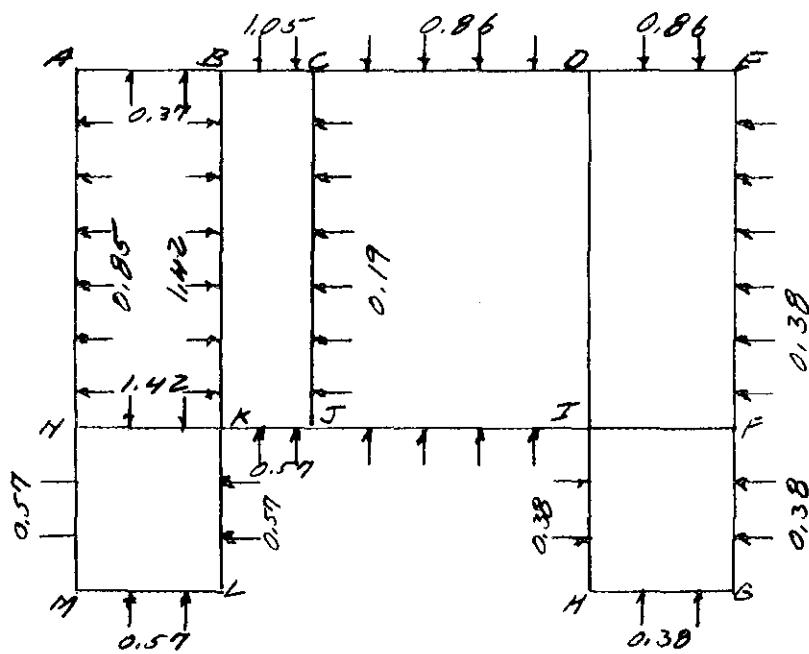
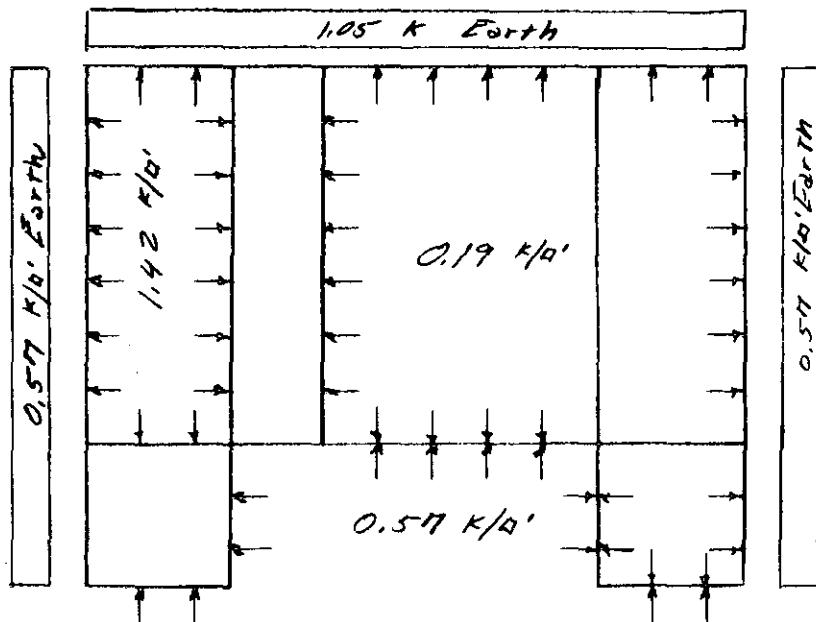
DESIGN OF WALLS

1. As Ring at El. 77.0 Outward Pressure

In discharge bay $P = (99.75 - 77) 0.0625 = 1.42 \text{ k/lb'}$

In sump bay $P = (80 - 77) 0.0625 = 0.19 \text{ k/lb'}$

Pressures from saturated earth as before



B-28

PROJECT CHICOOPEE FALLS
SUBJECT OAK ST. PUMPING STATION

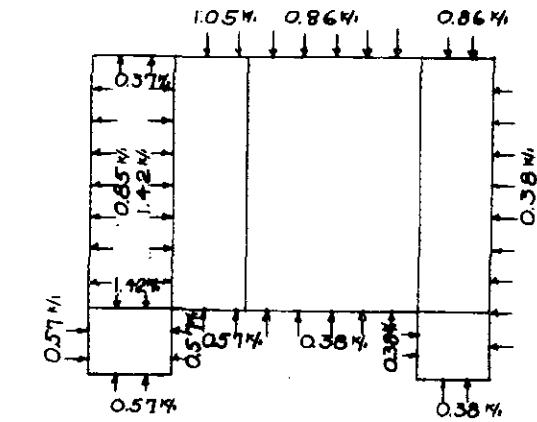
PROJECT NO. 6205
SHEET NO. 18 OF 1
DATE Feb. 27, 1963
COMPUTED BY F.N.W.
CHECKED BY M.A.

Design of Walls.

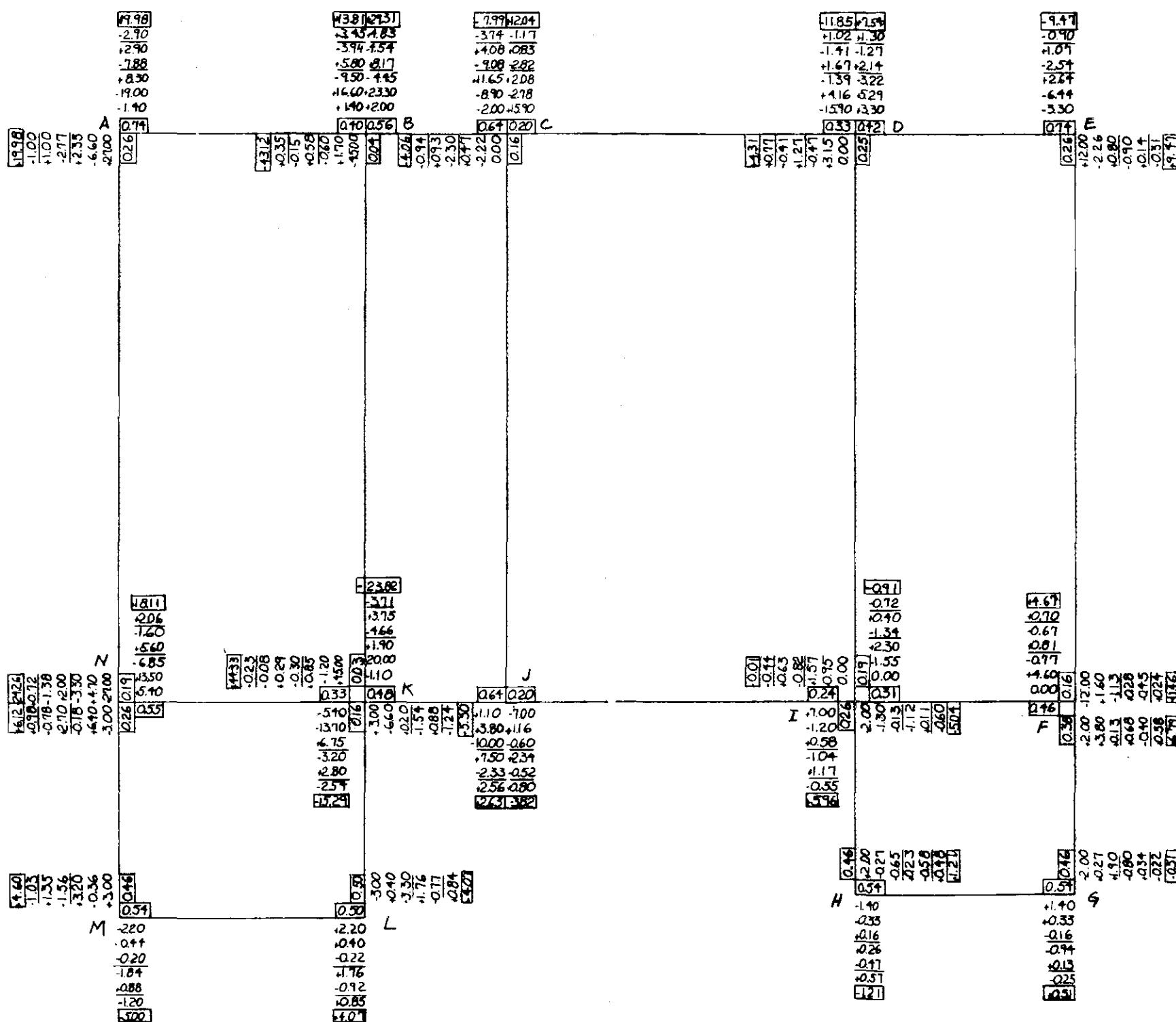
1. As Ring at El. 77.0 With Outward Pressure.
Fixed End Moments.

SPANS.

AB.	$M = 0.37 \times 6.75^2 / 12 =$	1.4^{\checkmark}	OUT.
BC.	$M = 1.05 \times 4.75^2 / 12 =$	2.0^{\checkmark}	IN.
CD	$M = 0.86 \times 14.92^2 / 12 =$	15.9^{\checkmark}	IN
DE	$M = 0.86 \times 6.75^2 / 12 =$	3.3^{\checkmark}	IN.
EF	$M = 0.38 \times 19.5^2 / 12 =$	12.0^{\checkmark}	IN.
FG	$M = 0.38 \times 8.0^2 / 12 =$	2.0^{\checkmark}	IN
GH	$M = 0.38 \times 6.75^2 / 12 =$	1.4^{\checkmark}	IN
HI	$M = 0.38 \times 8.0^2 / 12 =$	2.0^{\checkmark}	IN
IJ	$M = 0.38 \times 14.92^2 / 12 =$	7.0^{\checkmark}	IN.
JK	$M = 0.57 \times 4.75^2 / 12 =$	1.1^{\checkmark}	IN
KL	$M = 0.57 \times 8^2 / 12 =$	3.0^{\checkmark}	IN
LM	$M = 0.57 \times 6.75^2 / 12 =$	2.2^{\checkmark}	IN
MN	$M = 0.57 \times 8^2 / 12 =$	3.0^{\checkmark}	IN.
NA	$M = 0.85 \times 19.5^2 / 12 =$	27.0^{\checkmark}	OUT
CJ	$M = 0$ NOT CONSIDERED		
BK	$M = 1.42 \times 19.5^2 / 12 = 45.0^{\checkmark}$	OUT.	
DI	$M = 0$		
IF	$M = 0$		
NK	$M = 1.42 \times 6.75^2 / 12 = 5.4^{\checkmark}$	OUT.	



LOADING DIAGRAM



OAK STREET PUMPING STATION

MOMENT DISTRIBUTION AT ELEVATION 77.0 WITH WATER

NO SCALE

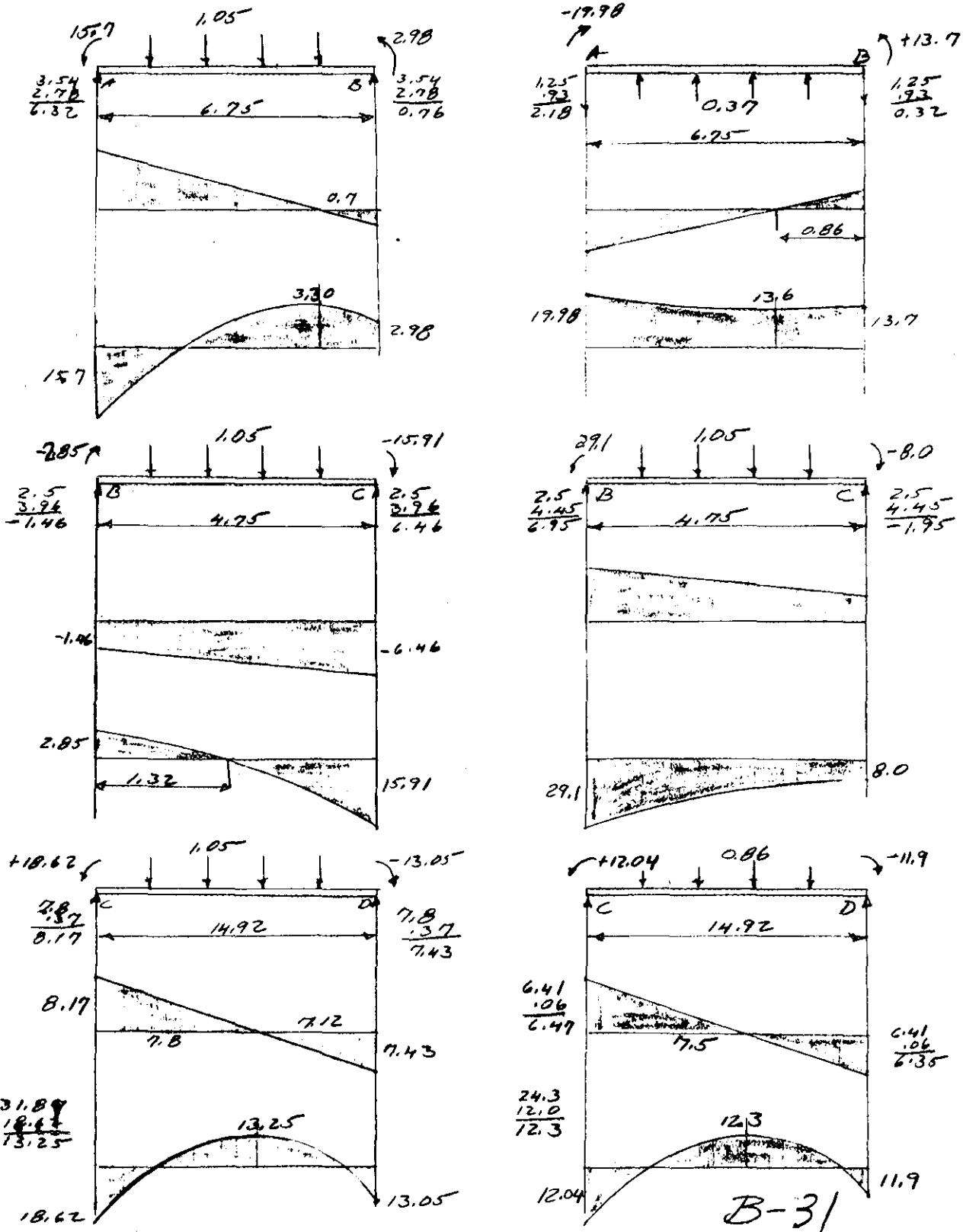
GREEN ENGINEERING AFFILIATES
ENGINEERS
BOSTON, MASS.

PROJECT CHICOPEE FALLS

SUBJECT OAK ST. PUMPING STATION

PROJECT NO. 6205-
SHEET NO. 19 OF
DATE Feb. 29, 1963
COMPUTED BY F.H.W.
CHECKED BY M.A.

DESIGN OF WALLS E1.77.0



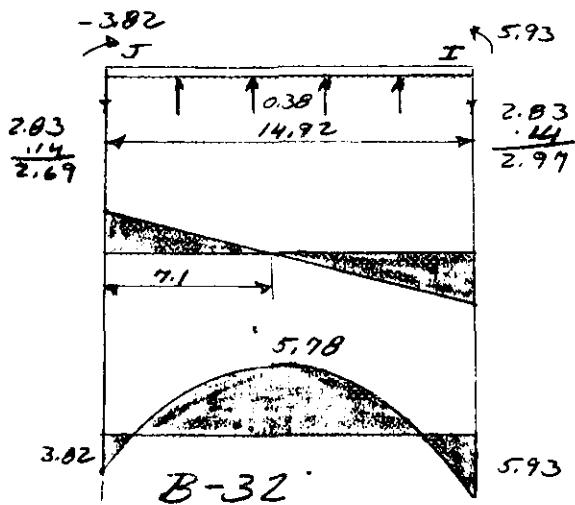
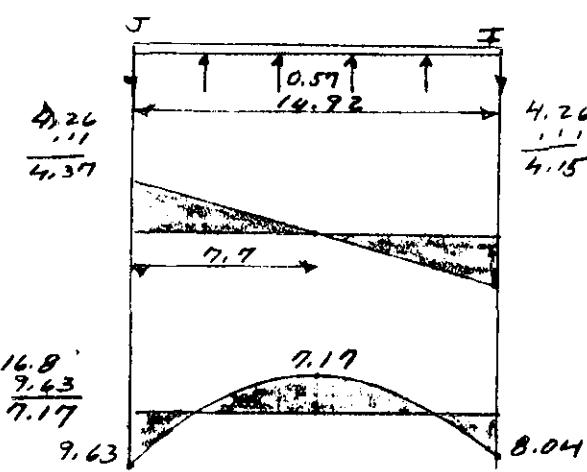
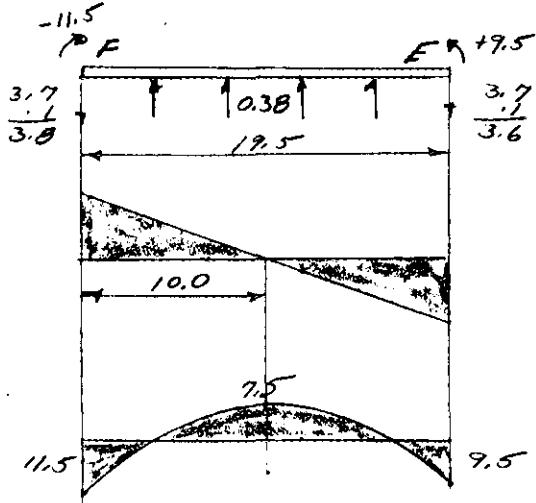
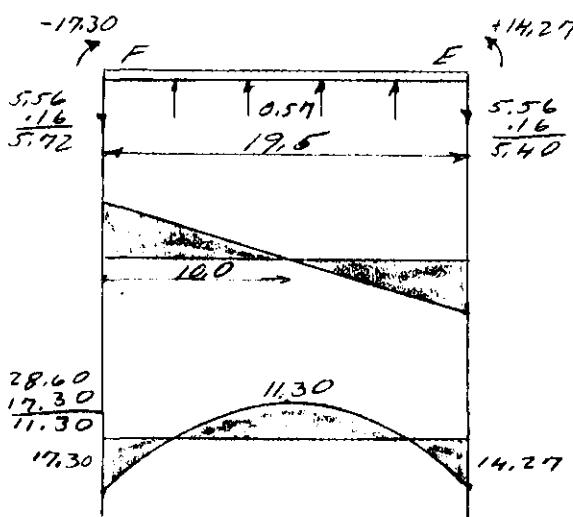
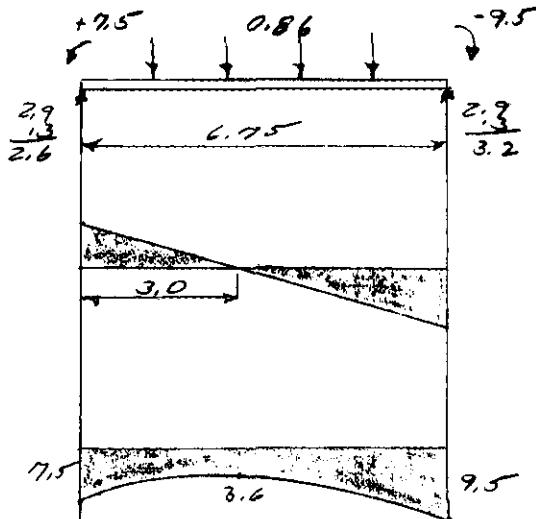
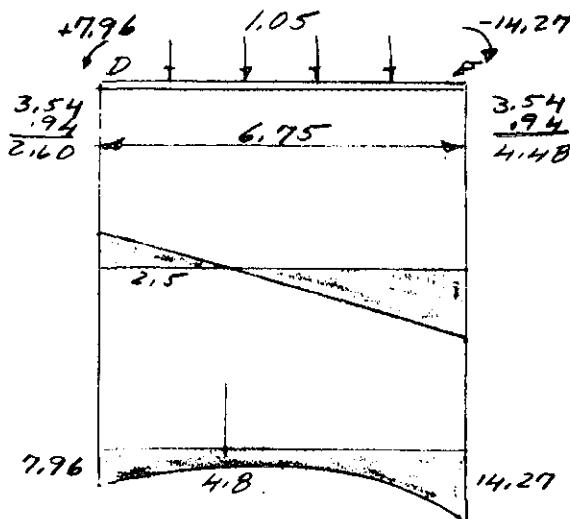
GREEN ENGINEERING AFFILIATES
ENGINEERS
BOSTON, MASS.

PROJECT CHICOPEE FALLS

SUBJECT OAK ST. PUMPING STATION

PROJECT NO. 6205-2
 SHEET NO. 20 OF 1
 DATE MAR. 4, 1963
 COMPUTED BY ENR
 CHECKED BY MMR

DESIGN OF WALLS EL. 77.0'



GREEN ENGINEERING AFFILIATES
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PROJECT CHIKOPEE FALLS
 SUBJECT OAK ST. PUMPING STATION

PROJECT NO. 6205-2

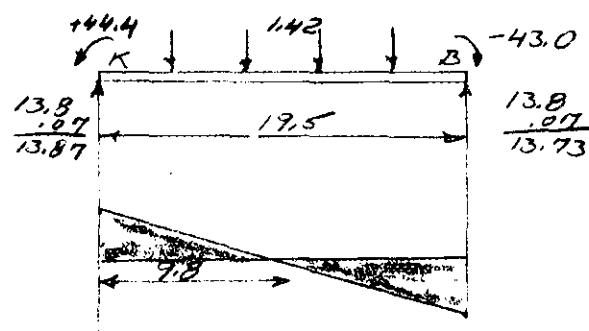
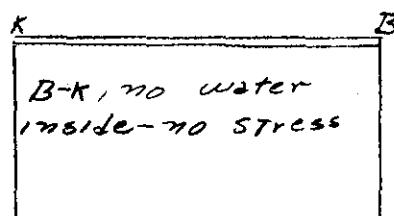
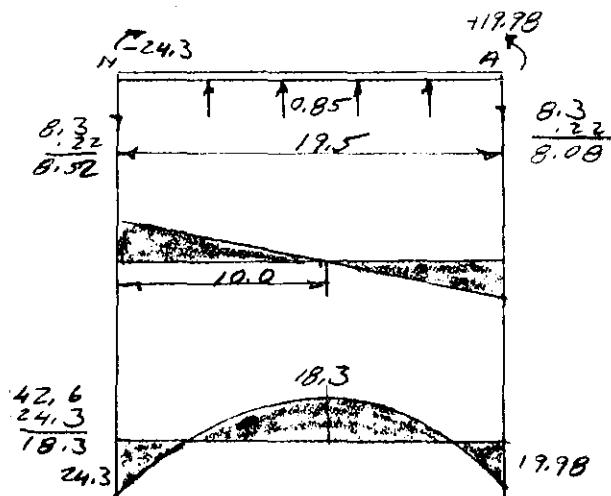
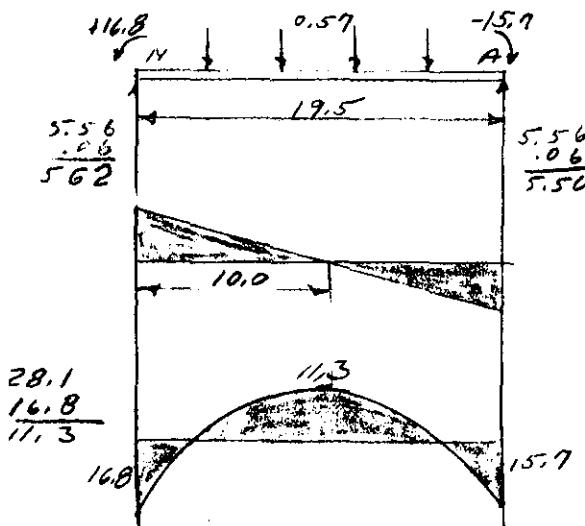
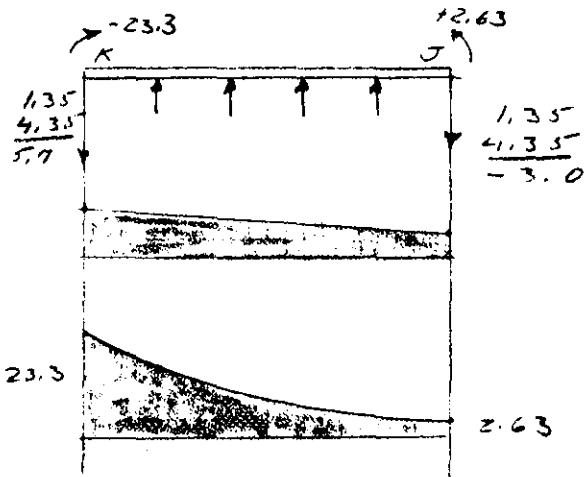
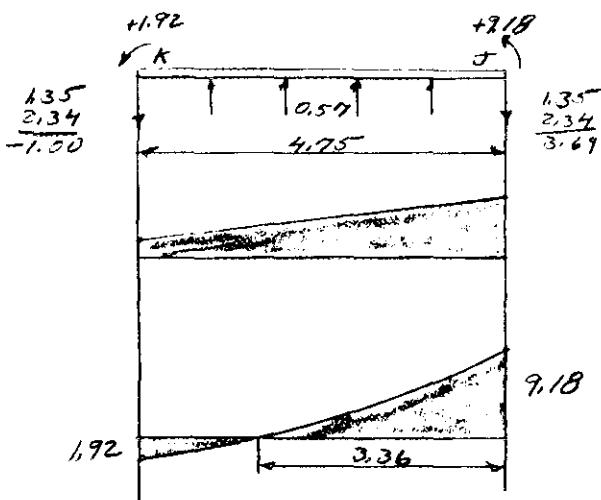
SHEET NO. 21 OF 1

DATE 11/21/63

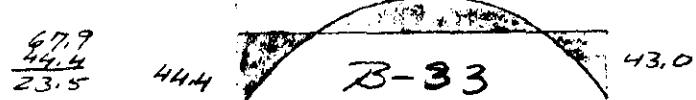
COMPUTED BY F.H.W.

CHECKED BY M.A.

DESIGN OF WALLS Elevation 0.00



BK - with water →



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PROJECT CHICOPEE FALLS

SUBJECT OAK ST PUMPING STATION

PROJECT NO. 6205-2

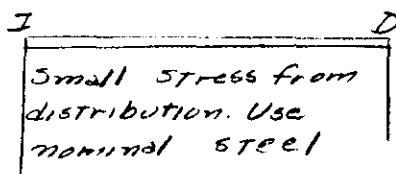
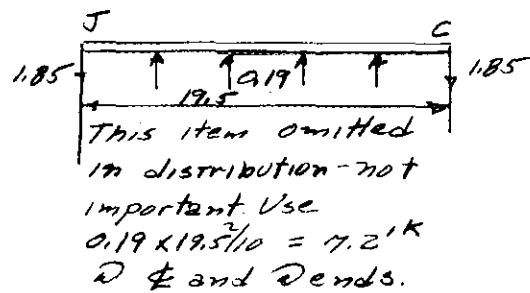
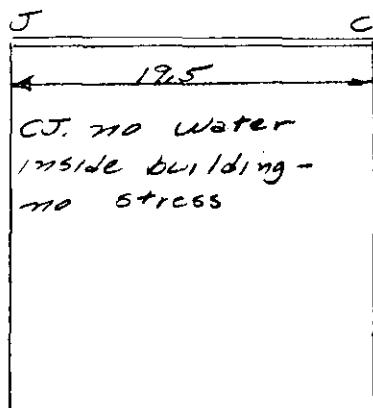
SHEET NO. 22 OF

DATE Mar. 4, 1963

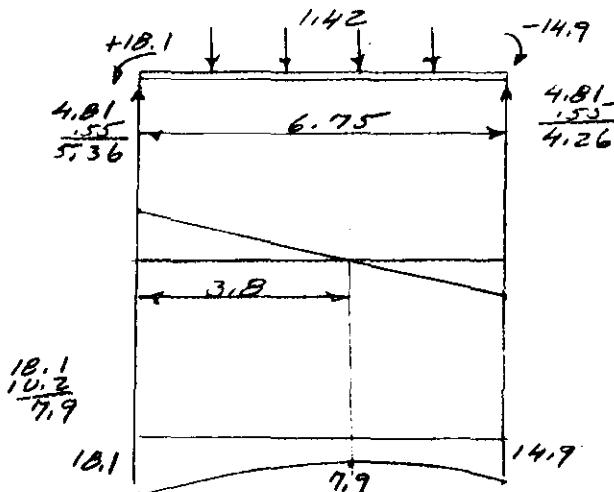
COMPUTED BY E.H.W.

CHECKED BY M.A.

DESIGN OF WALLS



8'x8' Intakes.
Run #5 @ 12" ea. Face
except @ joint F,
where steel from EF
will extend into FG.



GREEN ENGINEERING AFFILIATES
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PROJECT MASS. CHICOPEE FALLS

SUBJECT OAK ST. PUMPING STA.

REVISED DISTRIBUTION AT EL. 77.0 B.Z.K.

PROJECT NO. 6205-2

SHEET NO. 22A OF 1

DATE MAR. 3 1963

COMPUTED BY M.A.

CHECKED BY F.N.W.

STRESS ANALYSIS OF KB FOR WATER INSIDE SHOWS A 20" WALL
 NEEDED TO CARRY MOMENT AS FOUND USING A 12" WALL.
 SUCH A CHANGE IN THICKNESS WILL CAUSE QUITE A CHANGE
 IN MOMENT DISTRIBUTION IN KB AND ALL ADJACENT WALLS.
 WE SHALL REFIGURE THE MOMENT DISTRIBUTION ASSUMING
 FIXED ENDS ON ALL ADJACENT BEAMS AT FAR END.

+ 4.36	- 3.28	+ 3.05	- 1.48
+ .02 C	D + .04	+ .07	+ .03 C
+ .34 C	D + .68	+ .98	+ .49 C
+ 4.00 F	F - 4.00	+ 2.00	- 2.00 F

A	.34	.49	C
B			

0.4 M N	2
0.37 0	+
+ 1 +	+

4.2 V D

4A UD

	- .63		J
	- .05		+ 1.07
	- .58		C - .40
N		1.30	C - .04
- .29 F		K.421	+ .63
- .02 C		- 1.07 F	
(- 3.1)		- .81 D	
		- .08 D	
		- 1.96	

2.3	+	2
1.1	+	1
1.1	+	1

4U U

EXTERNAL PRESSURES

B-35

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PROJECT MASS CHICOPEE FALLS

SUBJECT OAK ST. PUMPING STA.

PROJECT NO. 6205-2
 SHEET NO. 22.C OF
 DATE MAR. 8, 1963
 COMPUTED BY M.A.
 CHECKED BY F.N.W.

$+ 6.26$ F + .04 C + .50 C + 7.10 F - 1.40	$+ 16.65$ D + ,09 D + .99 D + 14.20 F + 1.90	$+ 23.84$ + .12 + 1.42 + 20.30 + 2.00	$+ 8.92$ D + .06 D + .71 D + 10.15 F - 2.00
A	B	C	
	.17		
	$- 18.93$ D - .07 D - 1.06 D - 12.40 F - 5.40	$+ 5.00$ $+ 5.20$ $+ 5.55$ $+ 1.50$ $+ 1.00$ $+ 1.42$ $+ 1.46$	
	D	E	
	N	K	J
$+ 5.40$ F $- 6.20$ C $- .53$ C $- .03$ $- 1.36$	$+ 3.33$ $- 1.00$ $- 5.00$ $- 3.00$ $- 1.00$ $- 1.00$ $- 1.00$ $- 1.00$	$- 1.10$ F $- 17.50$ D $- 1.49$ D $- .11$ D $- 20.20$	$+ 1.10$ F $- 8.75$ C $- .74$ C $- .03$ C $- 8.44$
	L	M	
	AAA	LLL	
		$.30$ $.90$ $.50$ $.30$ $.10$ $.10$	

WATER + EXTERNAL PRESSURE

B-36

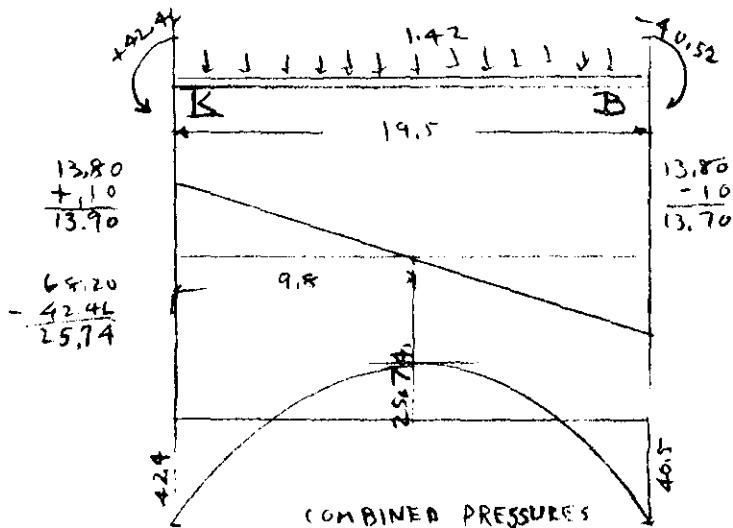
GREEN ENGINEERING AFFILIATES
ENGINEERS
BOSTON, MASS.

PROJECT MASS. CHICOPEE FALLS

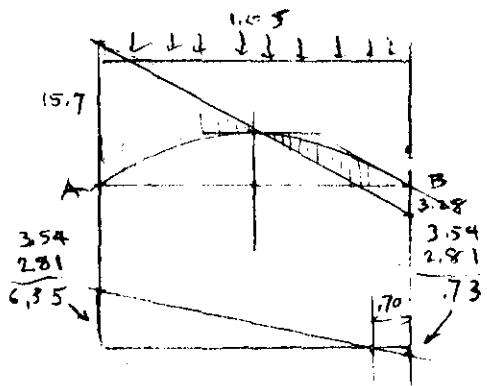
SUBJECT OAK ST. PUMPING STA.

PROJECT NO. 6205-2
SHEET NO. 22 E OF
DATE MAR. 8, 1963
COMPUTED BY M.A.
CHECKED BY F.W.

REVISED MOMENTS.



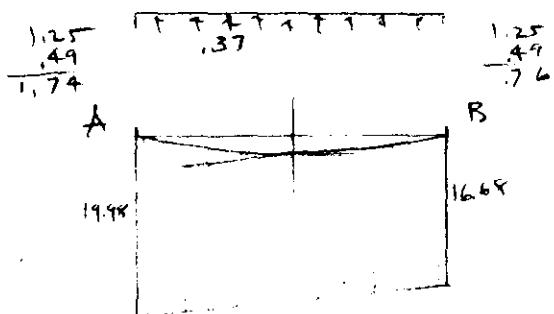
FOR THE REMAINDER OF THE BEAMS,
WE SHALL USE THE END MOMENT ADJACENT TO KB AS JUST
FOUND BUT SHALL USE THE PREVIOUS MOMENT FOR THE FAR END.



EXTERNAL LOADS

$$\frac{1}{2} \times 1.05 \times 6.75^2 = 5.98$$

$$\text{MAX. POS. } 1.73 \times \frac{16}{2} = .25 \\ \frac{3.28}{3.53}$$



COMBINED LOADS

$$\frac{1}{2} \times .37 \times 6.75^2 = 2.10$$

$$1.76 \times \frac{2.05}{2} = .78 \\ \frac{16.68}{15.70} = 1.08$$

B-37

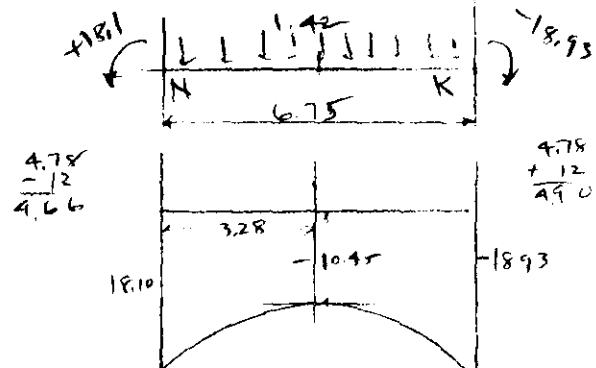
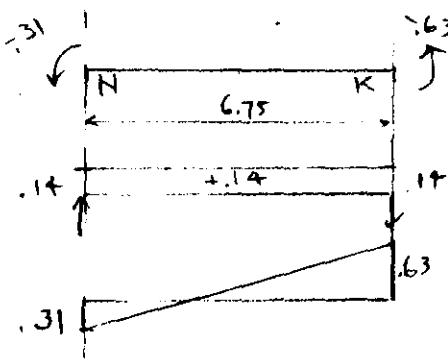
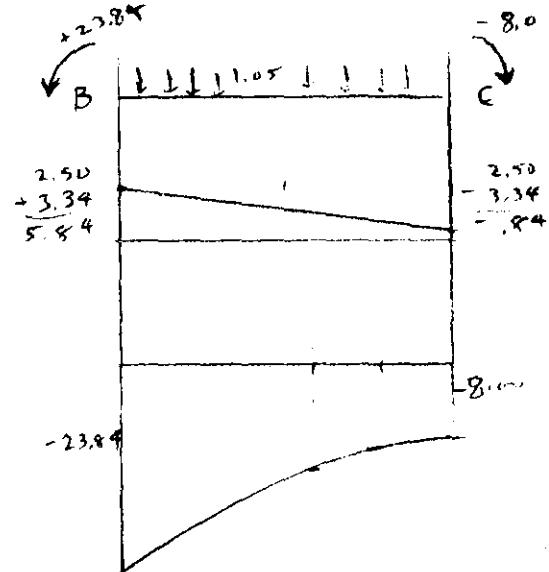
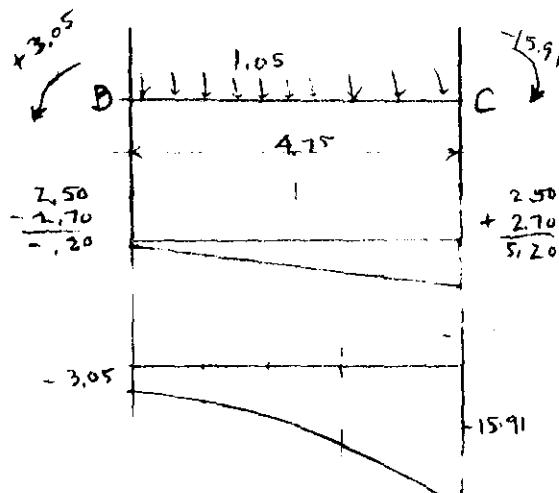
GREEN ENGINEERING AFFILIATES
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PROJECT MASS CHICOPEE FALLS.

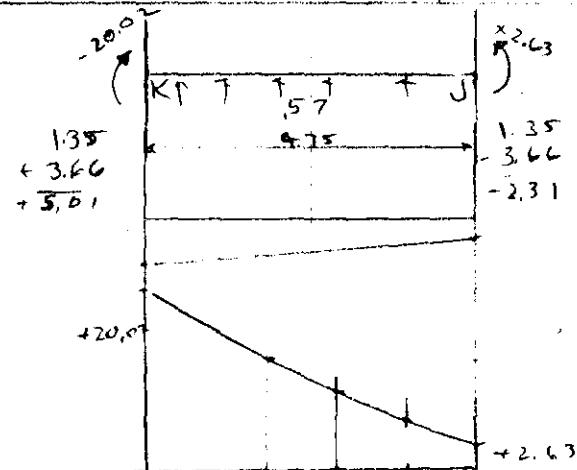
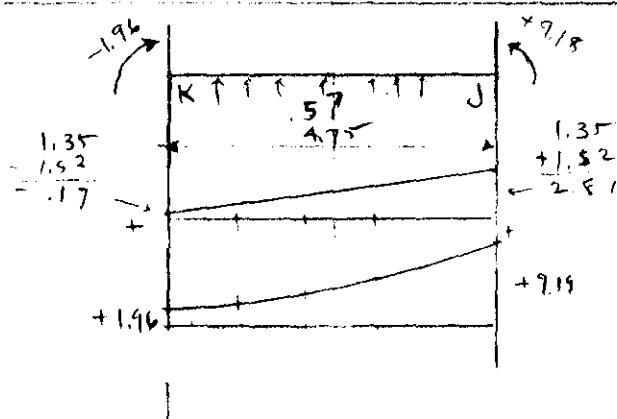
SUBJECT OAK ST. PUMPING STA.

REVISED MOMENTS

PROJECT NO. 6205-2
 SHEET NO. 22F OF OF
 DATE MAR. 8, 1963
 COMPUTED BY M.A.
 CHECKED BY F.I.W.



$$\text{MIN.M. } 4.66 \times \frac{3.25}{2} = 7.65$$

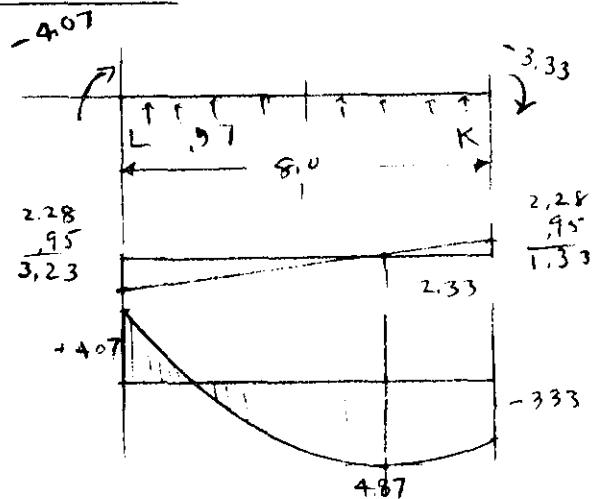
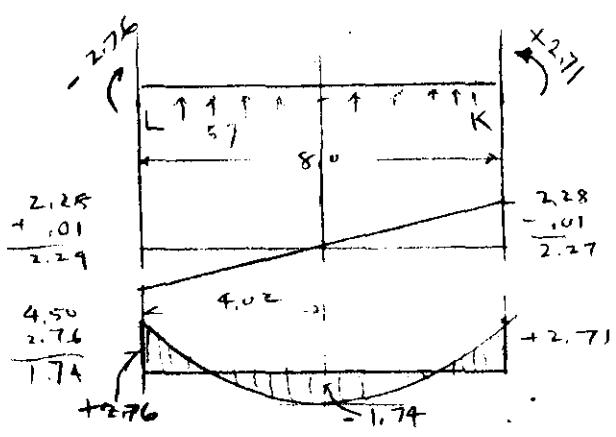


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BOSTON, MASS.

PROJECT MASS. CHICOPEE FALLS.

SUBJECT OAK ST. PUMPING STA.

PROJECT NO. 6205-2
 SHEET NO. 22G OF
 DATE MAR. 8, 1963
 COMPUTED BY M.A.
 CHECKED BY F.N.W.



B-39

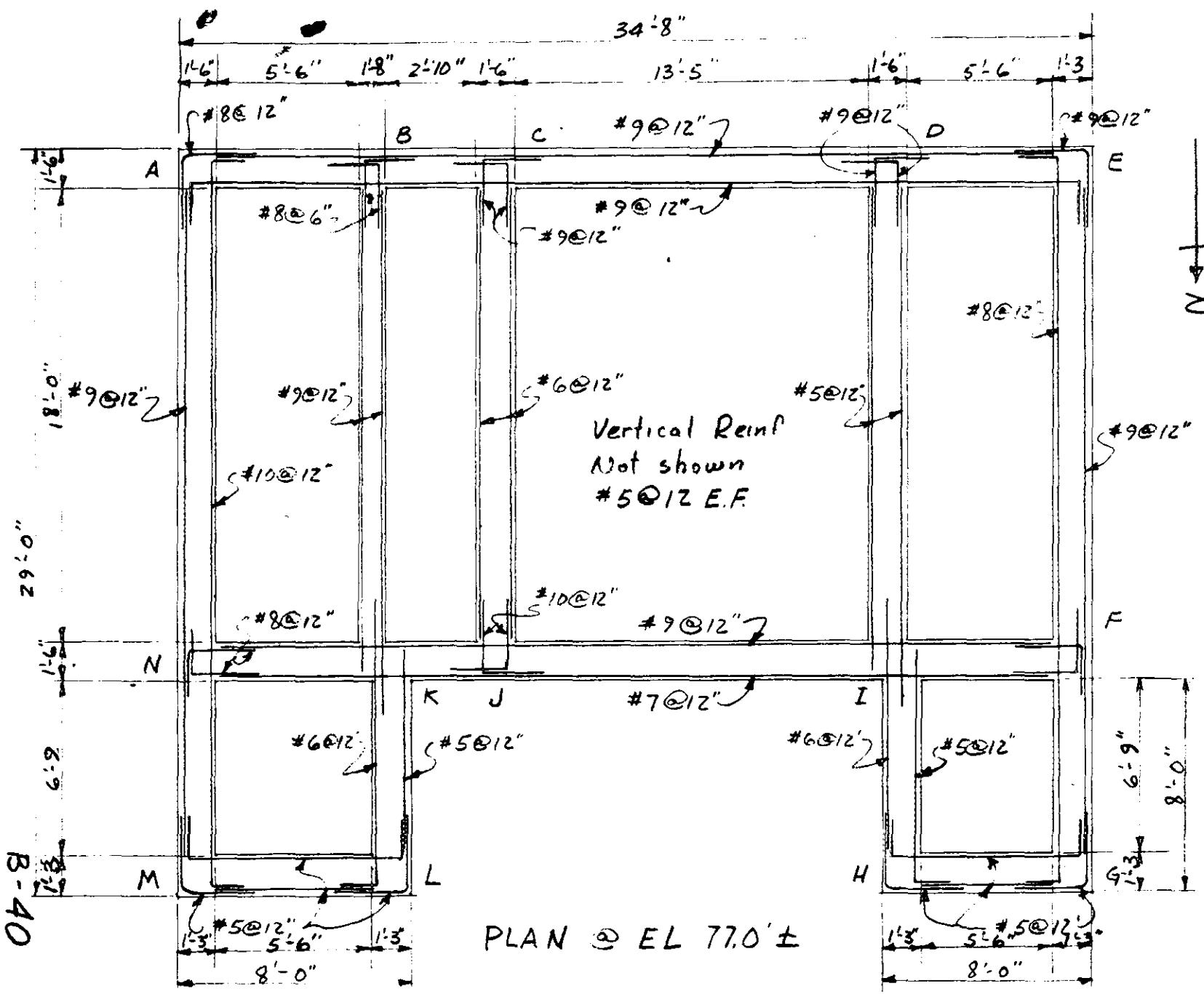
GREEN ENGINEERING AFFILIATES

BOSTON, MASS.

PROJECT Chicopee Falls

SUBJECT Oak St. Pumping Sta.

PROJECT NO. 6205
SHEET NO. 23
DATE Mar. 4, 1963
COMPUTED BY F.N.W.
CHECKED BY M.A. J.P.



GREEN ENGINEERING AFFILIATES
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BOSTON, MASS.

PROJECT CHICOOPEE FALLS

SUBJECT OAK ST. PUMPING STATION

PROJECT NO. 6205-2

SHEET NO. 24 OF 1

DATE MAR. 4, 1963

COMPUTED BY F.H.W.

CHECKED BY M.A.

DESIGN OF WALLS EL. 77.0

$$AB \frac{15.7}{1.44 \times 14.5} = 0.76 \text{ " (out)} \quad \# 8 \varnothing 12$$

$$\frac{19.90}{1.44 \times 14.5} = 0.96 \text{ (in)} \quad \# 9 \varnothing 12$$

$$BC \frac{29.1}{(1.44 \times 14.5)} = 1.4 \text{ (out)} \quad \# 8 \varnothing 6$$

$$CD \frac{18.62}{(1.44 \times 14.5)} = 0.9 \text{ (out)} \quad \# 8 \varnothing 12$$

$$DE \frac{7.76}{(1.44 \times 11.5)} = 0.48 \text{ (out)} \quad \# 7 \varnothing 12$$

$$\frac{14.27}{(1.44 \times 11.5)} = 0.86 \text{ (out)} \quad \# 9 \varnothing 12$$

$$EF \frac{11.3}{(1.44 \times 11.5)} = 0.68 \text{ (in)} \quad \# 8 \varnothing 12$$

$$\frac{17.3}{(1.44 \times 11.5)} = 1.04 \text{ (out)} \quad \# 9 \varnothing 12$$

$$IJ \frac{9.63}{(1.44 \times 14.5)} = 0.46 \text{ (out)} \quad \# 6 \varnothing 12$$

$$\frac{7.17}{(1.44 \times 14.5)} = 0.35 \text{ (in)} \quad \# 6 \varnothing 12$$

$$JK \frac{23.3}{(1.44 \times 14.5)} = 1.12 \text{ (out)} \quad \# 10 \varnothing 12$$

$$HK \frac{18.93}{(1.44 \times 14.5)} = 0.91 \quad \# 9 \varnothing 12$$

$$HA \frac{24.3}{(1.44 \times 14.5)} = 1.17 \text{ (in)} \quad \# 10 \varnothing 12$$

$$\frac{16.8}{(1.44 \times 14.5)} = 0.81 \text{ (out)} \quad \# 8 \varnothing 12$$

$$\frac{11.3}{(1.44 \times 14.5)} = 0.55 \text{ (in)} \quad \# 7 \varnothing 12$$

$$\frac{18.3}{(1.44 \times 14.5)} = 0.88 \text{ (out)} \quad \# 9 \varnothing 12$$

$$BK d = \sqrt{\frac{44400 \times 12}{160 \times 12}} = 16.5 + 3.5 = 20$$

$$\frac{44.4}{(1.44 \times 16.5)} = 1.88 \quad \# 9 \varnothing 6$$

$$\frac{25.7}{(1.44 \times 16.5)} = 1.06 \quad \# 9 \varnothing 12$$

$$CJ \frac{7.2}{(1.44 \times 14.5)} = 0.346 \quad \# 6 \varnothing 12$$

$$\text{Intakes } 6.8 / (1.44 \times 11.5) = 0.41 = \text{max}$$

$$\text{If } M \geq 5.0'K \text{ use } \# 5 \varnothing 12$$

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PROJECT CHICOREE FALLS

SUBJECT OAK ST PUMPING STATION

PROJECT NO. 6205
 SHEET NO. 25 OF 1
 DATE MAR. 5, 1963
 COMPUTED BY F.H.W.
 CHECKED BY M.A.

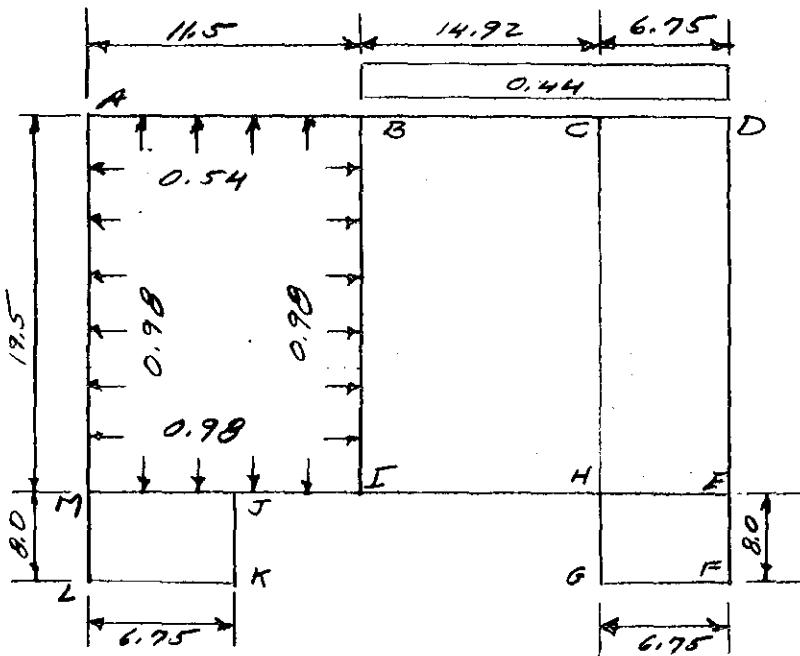
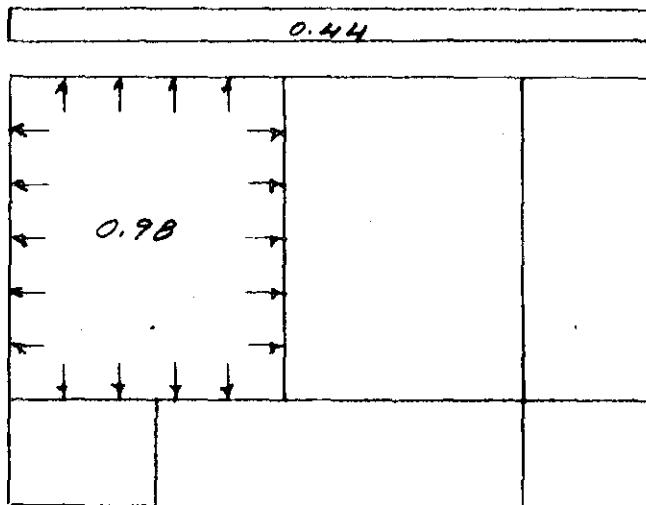
Design of walls El. 84.0 As Ring.

In discharge bay $p = (99.75 - 84.0) 0.0625 = 0.98$

West Wall Earth pres. = $(89.0 - 84.0) 0.087 = 0.44$

Submerged Earth $(135 - 62.5) \frac{1}{3} = 0.0625 + 0.0242 = 0.087$

Earth on other sides exerts no pressure



B-42

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PROJECT CHICAGO FALLS

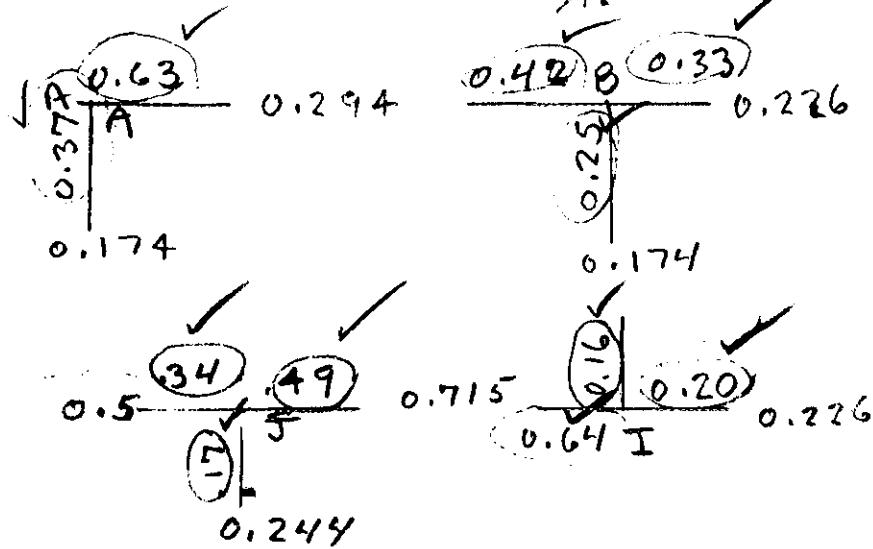
SUBJECT OAK ST. PUMPING STATION

PROJECT NO. 6205
SHEET NO. 26 OF 1
DATE Mar. 5, 1943
COMPUTED BY J. W.
CHECKED BY M. A.

Design of IVols. Ring at El. 34.0

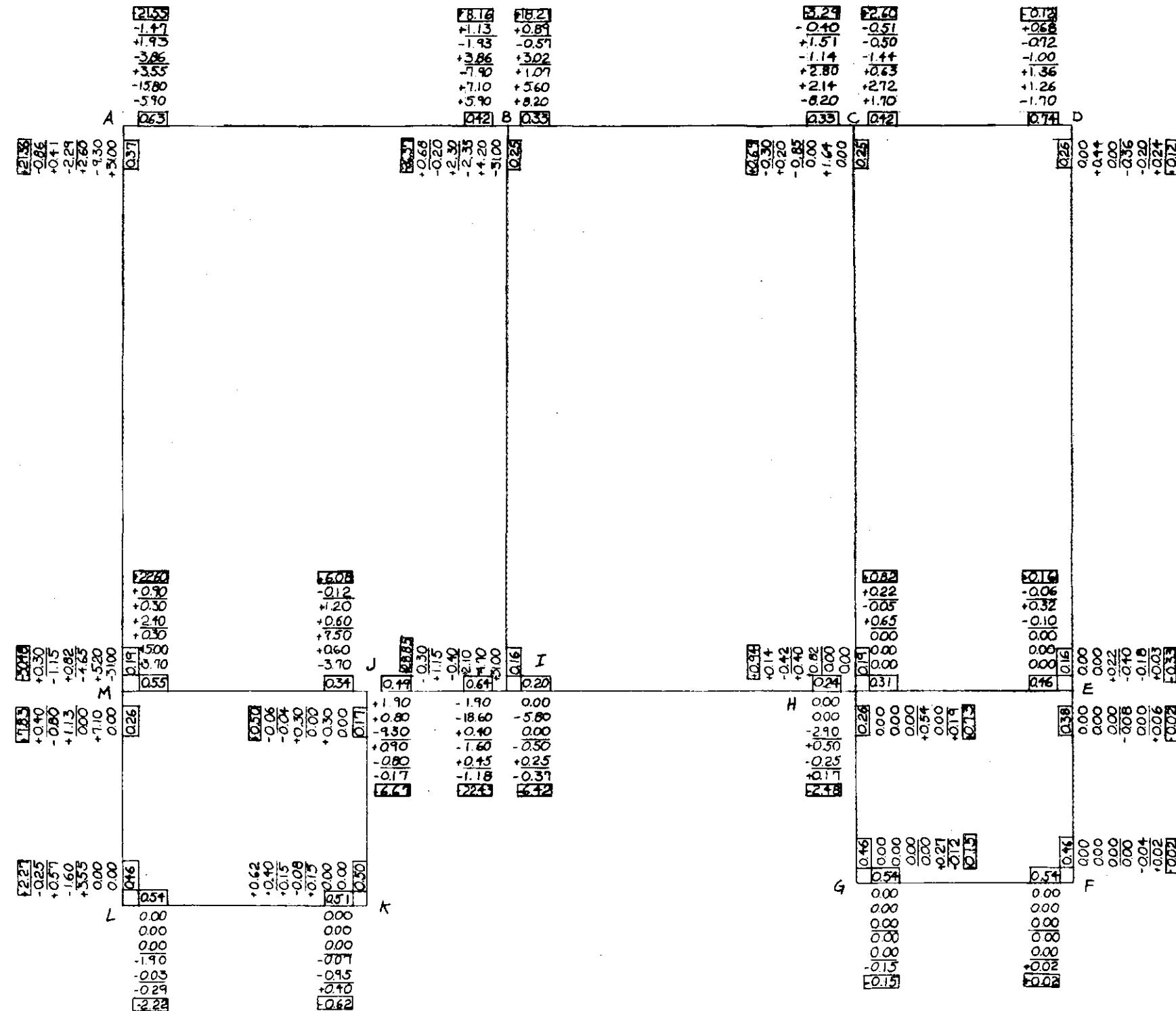
$$\begin{array}{ll}
 AB. M = 0.54 \xrightarrow{2} 11.5^2/12 & 5.9 \checkmark \\
 BC. M = 0.44 \xrightarrow{2} 14.92^2/12 & 8.2 \checkmark \\
 CD. M = 0.44 \xrightarrow{2} 6.75^2/12 & 1.7 \checkmark \\
 IJ. M = 0.98 \xrightarrow{2} 4.75^2/12 & 1.9 \checkmark \\
 JM. M = 0.98 \xrightarrow{2} 6.75^2/12 & 3.7 \checkmark \\
 NH. M = 0.98 \xrightarrow{2} 19.5^2/12 & 31 \checkmark \\
 BI. M = 0.98 \xrightarrow{2} 19.5^2/12 & 31 \checkmark \\
 \end{array}$$

$$\begin{array}{l}
 I/l = \frac{1.5^3}{11.5} = 0.294 \\
 I/l = \frac{1.5^3}{14.92} = 0.226 \\
 I/l = \frac{1.5^3}{4.75} = 0.715 \\
 I/l = \frac{1.5^3}{6.75} = 0.5 \\
 I/l = \frac{1.5^3}{19.5} = 0.174 \\
 I/l = \frac{1.5^3}{19.5} = 0.174
 \end{array}$$

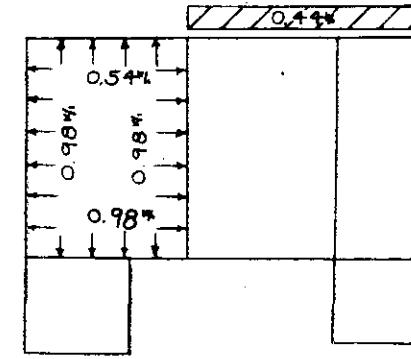


Other values as at El. 77.0

B-43



OAK STREET PUMPING STATION
MOMENT DISTRIBUTION AT ELEVATION 84.0 WITH WATER
NO SCALE



LOADING DIAGRAM

GREEN ENGINEERING AFFILIATES
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PROJECT CHICOOEE FALLS

SUBJECT OAK ST. PUMPING STATION

PROJECT NO. 6205

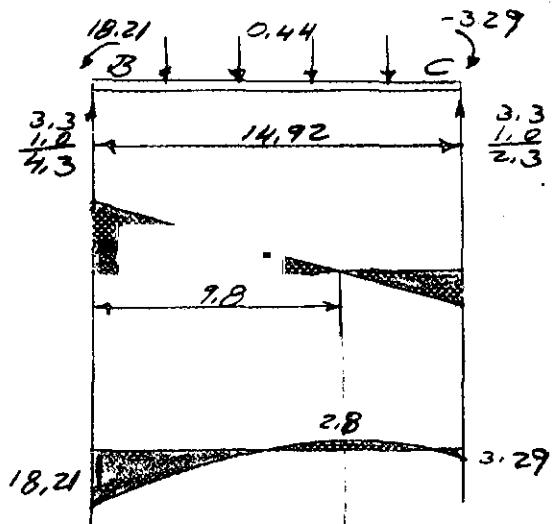
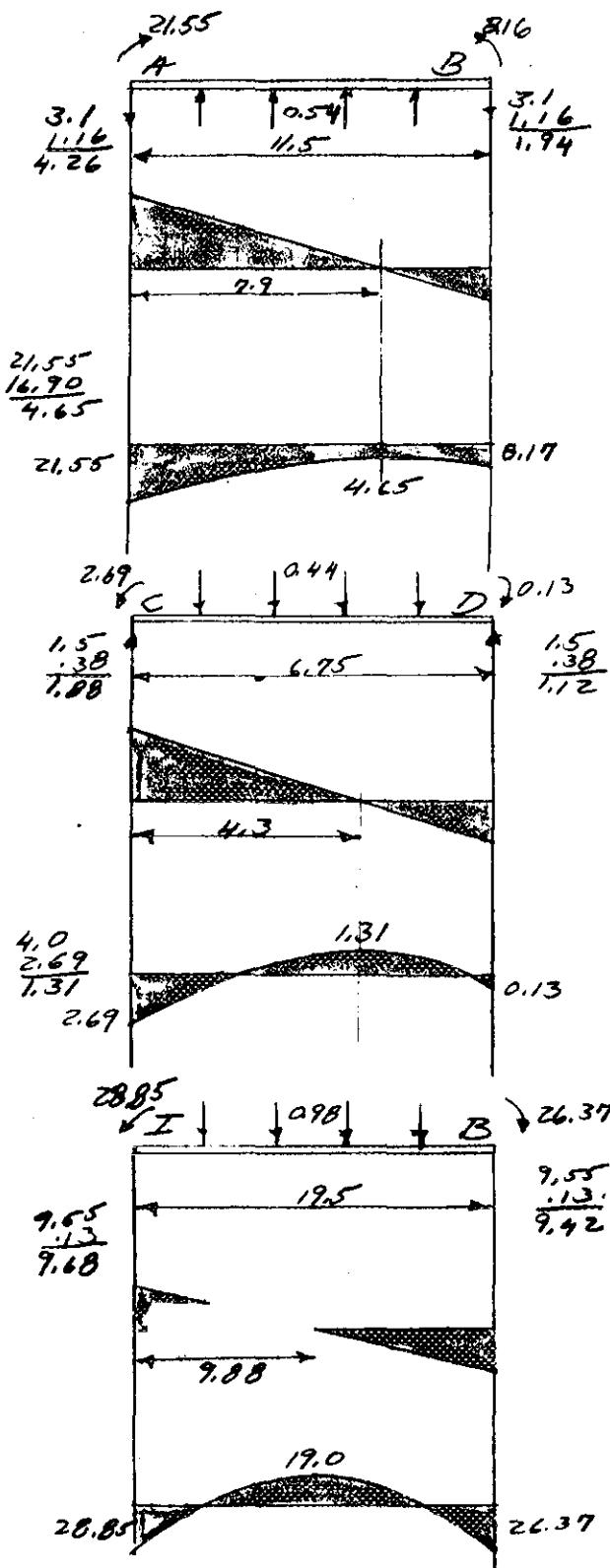
SHEET NO. 27 OF 1

DATE MAY 5, 1963

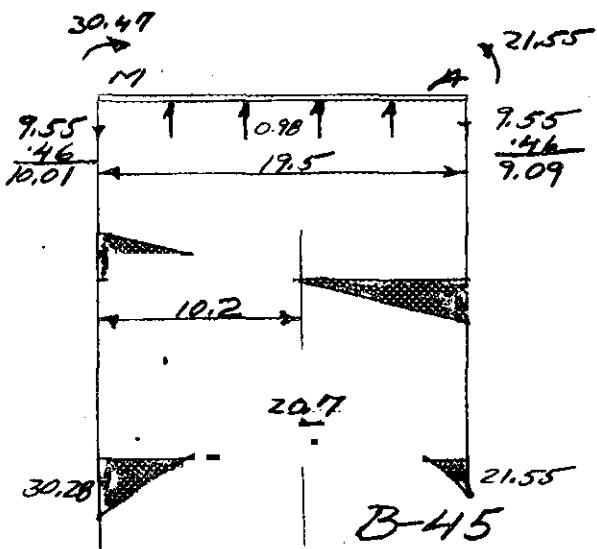
COMPUTED BY FHW

CHECKED BY MAB

DESIGN OF WALLS. RING 2 AT EL. 84.0



Nominal steel in
 DE, EF, FG, GH, HE,
 CH, HI, JK, KL



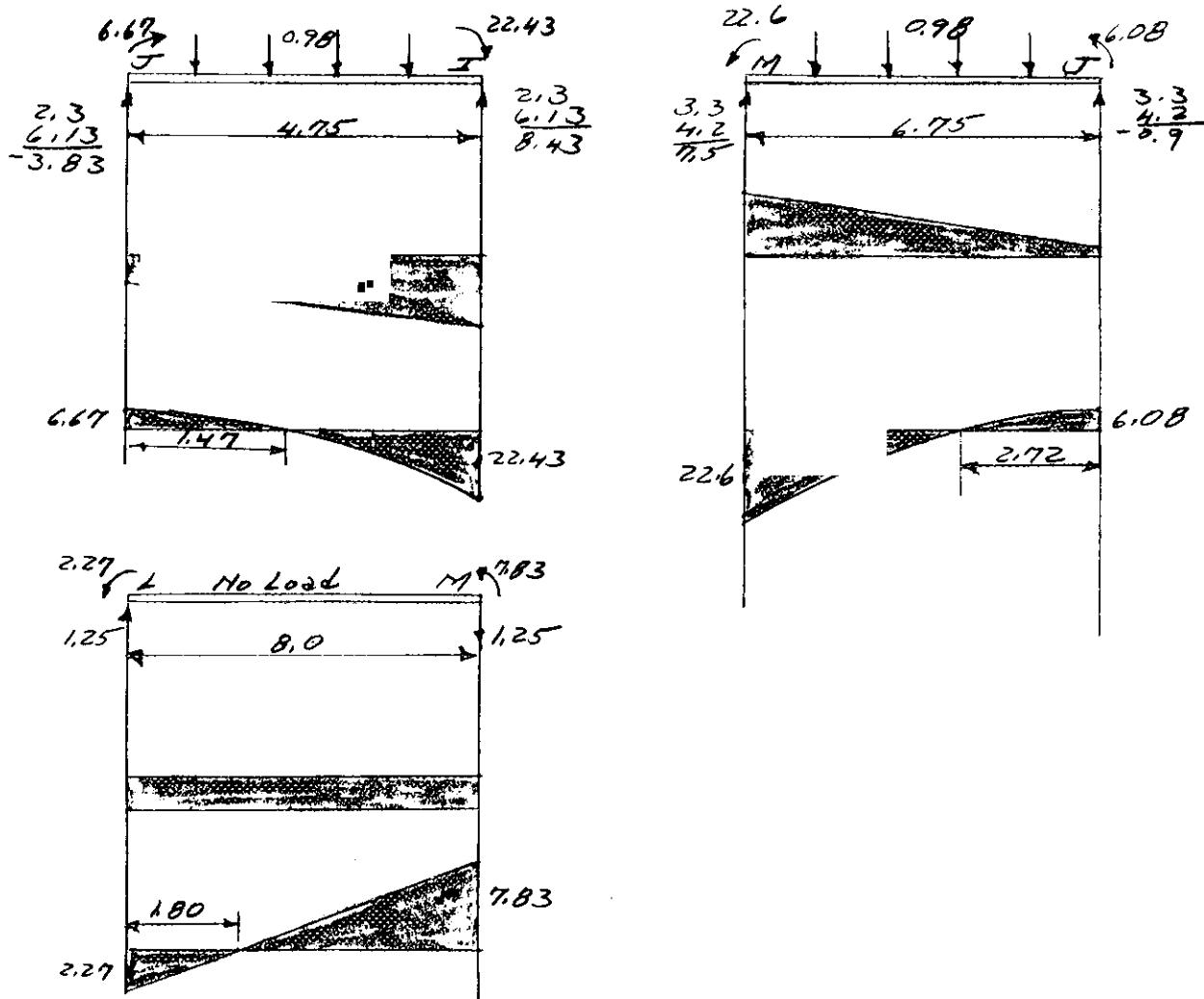
GREEN ENGINEERING AFFILIATES
ENGINEERS
 BOSTON, MASS.

PROJECT CHICOPEE FALLS

SUBJECT OAK ST. PUMPING STATION

PROJECT NO. 6205-2
 SHEET NO. 28 OF 1
 DATE MAR 6, 1963
 COMPUTED BY F.H.W.
 CHECKED BY M.P.

DESIGN OF WALLS @ \$1.84.00



B-46

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PROJECT CHICOOPEE FALLS

SUBJECT OAK ST PUMPING STATION

PROJECT NO. 6205
SHEET NO. 29 OF 1
DATE MAR. 6, 1963
COMPUTED BY F.H.W.
CHECKED BY M.A.

DESIGN OF WALLS, RING @ E1 84.0

AB	$21.55 / (1.44 \times 14.5)$	= 1.04	#9 @ 12
BC	$18.21 / (1.44 \times 14.5)$	= 0.88	#9 @ 12
CD	Normal		
DI	$28.85 / (1.44 \times 14.5)$	= 1.38	#8 @ 6
	$19.75 / (1.44 \times 15.5)$	= 0.88	#9 @ 12
	$26.37 / (1.44 \times 14.5)$	= 1.26	#10 @ 12
MA	$30.28 / (1.44 \times 14.5)$	= 1.45	#8 @ 6
IJ	$6.67 / (1.44 \times 15.5)$	= 0.30	#5 @ 12
	$22.43 / (1.44 \times 15.5)$	= 1.00	#9 @ 12
NJ	$22.6 / (1.44 \times 14.5)$	= 1.08	#10 @ 12
LM	$7.83 / (1.44 \times 12.5)$	= 0.43	#6 @ 12

COVER ALL WALLS 3" + 1/2 @ THIS ELEV.

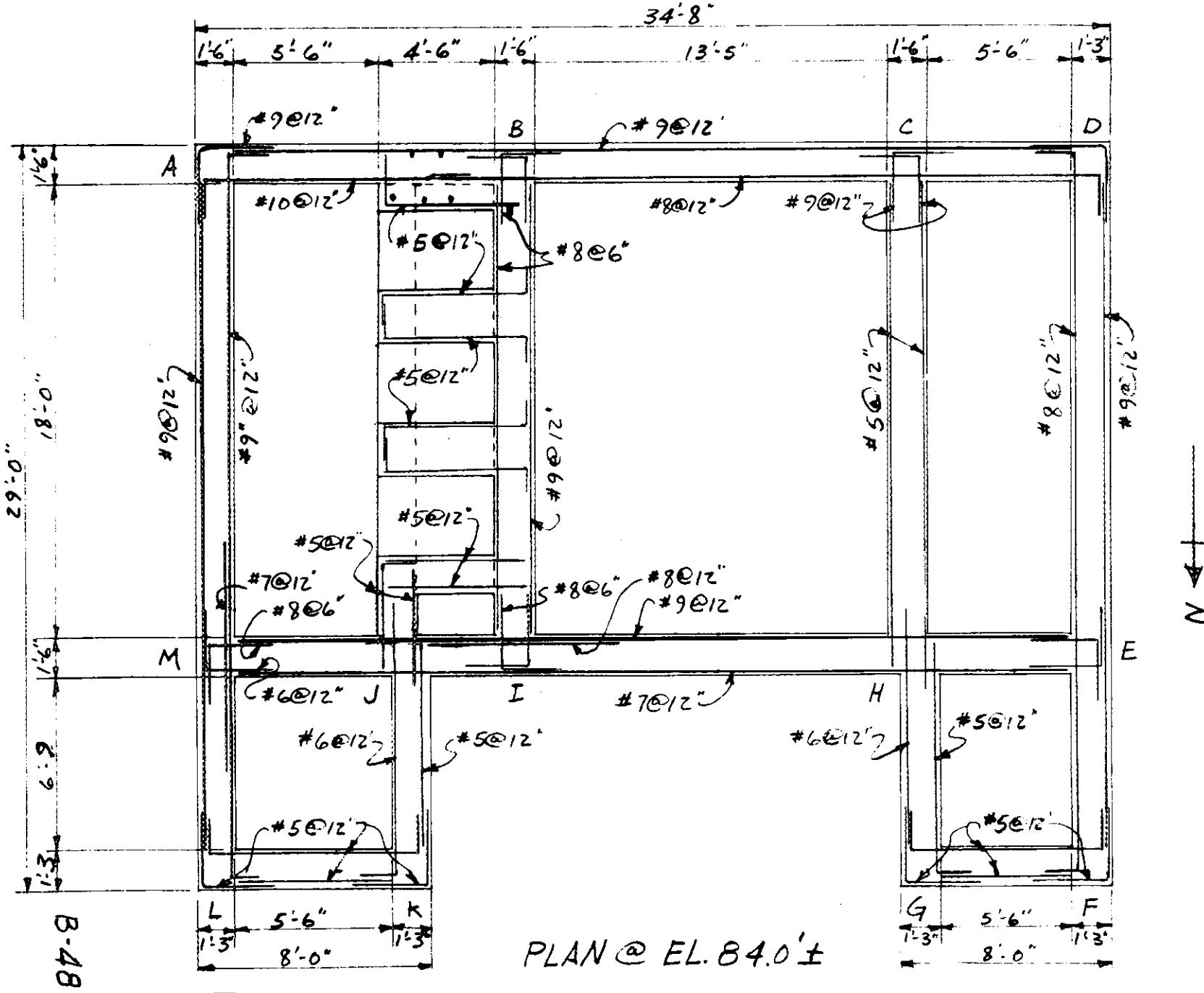
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PROJECT Chicopee Falls

PROJECT NO. 6205
SHEET NO. 29A OF 3
DATE 3/14/63
COMPUTED BY FNU

CHECKED BY FNU

SUBJECT Oak St. Pumping Sta



B-48

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PROJECT MASS. CHICOPEE FALLS

SUBJECT OAK ST. PUMPING STA.

PROJECT NO. 6205-2
SHEET NO. 30 A OF
DATE MAR. 12/1963
COMPUTED BY MA.
CHECKED BY FNW

THE QUESTION OF AXIAL TENSION IN RING @ EL. 84
THE RESULTS OF CONSIDERATION OF AXIAL TEN. IN RING AT EL. 87
MAKE IT SEEM THAT TEN. IN LONG SIDES IS UNIMPORTANT,
TENSION IN SHORT SIDES DOES HAVE A SIGNIFICANT EFFECT.
WE THEREFORE CONSIDER TENSION IN A-B, M-J AND J-I
TEN IS SHEAR IN MA = 9.15 @ A 10.05 ATM.

$$A-B. M \Delta = 21.55 \quad N = -9.15 \quad d'' = 9 - 3\frac{1}{2} - 5\frac{1}{2}$$

$$e = \frac{12M}{N} + 5\frac{1}{2} = \frac{12 \times 21.55}{-9.15} + 5\frac{1}{2} = -28.2 + 5.5 = -22.7 \quad E = 1.89$$

$$i = \frac{1}{1 - \frac{875 \times 14.5}{-22.7}} = \frac{1}{1 + 5.56} = .16 \quad NE = 17.3$$

$$A_s = \frac{17.3}{1.44 \times 14.5 \times .16} = 1.30 \quad \pm 10\% 12$$

$$A-B. M \leq B, 8.17 \quad N = -9.15$$

$$e = \frac{12 \times 8.17}{-9.15} + 5.5 = -10.70 + 5.5 = -5.20 \quad E = .433$$

$$i = \frac{1}{1 - \frac{875 \times 14.5}{-5.20}} = \frac{1}{1 + 2.44} = .29$$

$$A_s = \frac{3.96}{1.44 \times 14.5 \times .29} = .65 \quad \pm 8\% 12$$

$$A-B. M \text{ IN MIDDLE} = 4.65$$

$$e = \frac{12 \times 4.65}{-9.15} + 5.5 = -6.10 + 5.5 = -.60 \quad E = .05$$

$$i = \frac{1}{1 - \frac{875 \times 14.5}{-.60}} = \frac{1}{1 + 21.2} = .045$$

$$A_s = \frac{.46}{1.44 \times 14.5 \times .045} = .49 \quad \pm 7\% 12$$

SAME SIDE AS ENDS.

$$BM. M-J \quad M_{AM} @ M. = 22.6 \quad N = 10.05$$

$$e = \frac{12 \times 22.6}{-10.05} + 5.5 = -27.0 + 5.5 = -21.5 \quad E = -1.79$$

$$i = \frac{1}{1 - \frac{875 \times 14.5}{-21.5}} = \frac{1}{1 + 5.9} = .163$$

$$A_s = \frac{18.06}{1.44 \times 14.5 \times .163} = 1.37 \quad \pm 8\% 6$$

$$M_{AM} @ J = 6.08$$

$$e = \frac{12 \times 6.08}{-10.05} + 5.5 = -7.25 + 5.5 = -1.75 \quad E = -1.46 \quad NE = 1.47$$

$$i = \frac{1}{1 - \frac{875 \times 14.5}{-1.75}} = \frac{1}{1 + 7.25} = .121$$

$$A_s = \frac{1.47}{1.44 \times 14.5 \times .121} = .58 \quad \pm 7\% 12$$

B-49

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PROJECT MASS. CHICOPEE FALLS

SUBJECT OAK ST. PUMPING STA.

RING @ 84

PROJECT NO. 6205-2

SHEET NO. 30B OF 1

DATE MAR. 12, 1963

COMPUTED BY M.A.

CHECKED BY FNW

BM. J.I. AT J SIMILAR TO END J OF BM. M-J
 @ I. H = 22.43 N = 10.05

$e = \frac{12 \times 22.43}{-10.05} + 5.56$ VERY SIMILAR TO END M OF
 BEAM, M-J - SAME STEEL.

#7@12" see Sh 30A

(#10C12) A (#8C12) B

REVISIONS, TO BMS
 A-B, M-J & J-I
 CAUSED BY CONSIDER-
 ING. AXIAL TENSION

M #8C6 J #8C6 I

#7@12

B-50

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PROJECT CITICOPEE FALLS

SUBJECT OAK ST. PUMPING STATION

PROJECT NO. G205
SHEET NO. 31 OF
DATE Mar. 6, 1963
COMPUTED BY F.N.W.
CHECKED BY M.A.

Design of Walls. Ring at El. 87.0

In discharge bay, $p = (99.75 - 87.0) \cdot .0625 = 0.8$

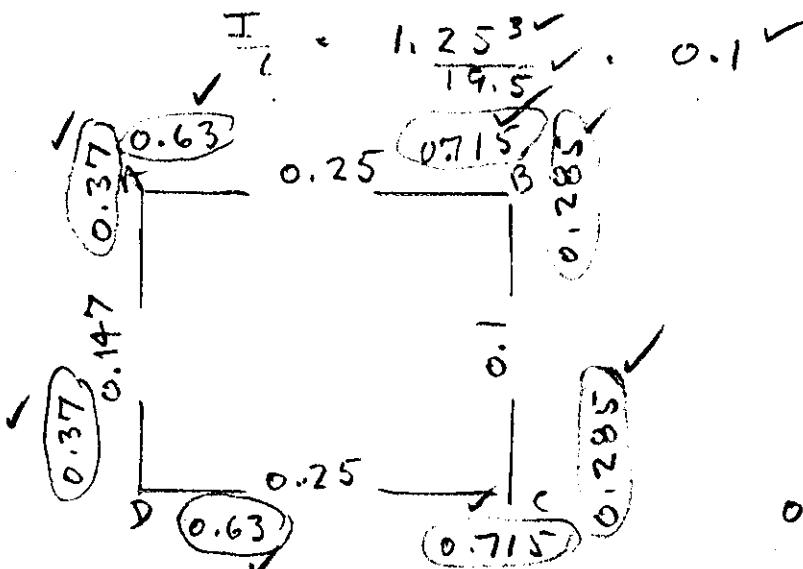
$$AB \quad M = 0.8 \cdot 11.5 \frac{3}{2} = 8.8 \quad \checkmark$$

$$CD \quad \frac{I}{2} = \frac{1.42^3}{11.5} = 0.250 \quad \checkmark$$

$$AD \quad M = 0.8 \cdot 19.5 \frac{1}{2} = 25.4 \quad \checkmark$$

$$\frac{I}{2} = \frac{1.42^3}{19.5} = 0.147 \quad \checkmark$$

$$BC \quad M = 0.8 \cdot 19.5 \frac{1}{2} = 25.4 \quad \checkmark$$



Neglect pump

room bay - no load.
With 12" walls
effect front discharge
bay will be small.

$$+8.8$$

0.25	5	0.067
	2	$\frac{3}{14.92}$
	1	

$$0.25 \cdot 0.067 = 0.167$$

$$0.167 / 417 = 0.417$$

$$0.167 / 417 = 0.24$$

$$0.167 / 417 = 0.16$$

$$\frac{25.4}{16.6} = 0.16 = 2.65''$$

$$= 15 @ 12.$$

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PROJECT CHICOPEE FALLS

SUBJECT OAK ST. PUMPING STATION

PROJECT NO. 6205

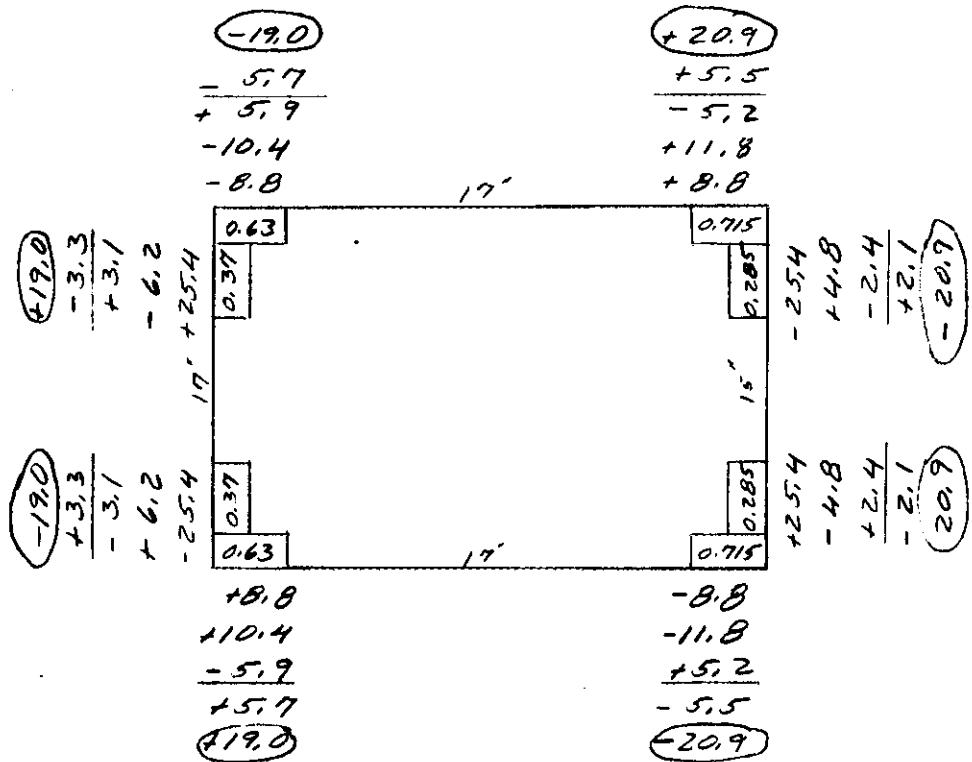
sheet no. 37 of

DATE Mar. 6, 1963

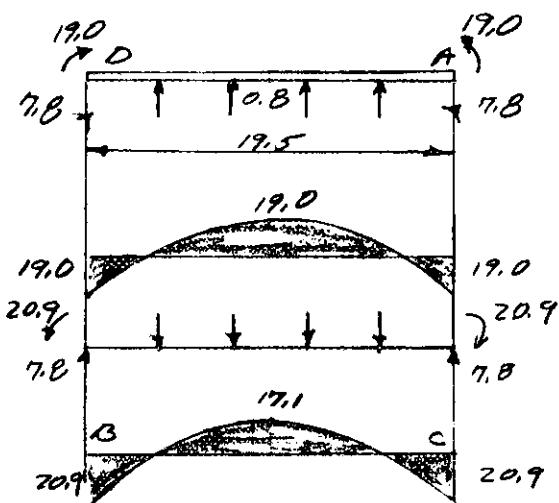
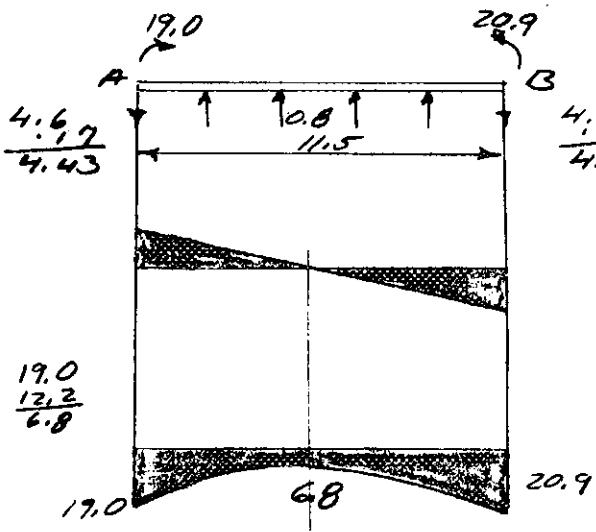
COMPUTED BY E.H.W

CHECKED BY M.B.

DESIGN OF WALLS. RING D.E.I. 870



Cover 2" + d/2
 $= 14.5 \text{ ft } 12.5$



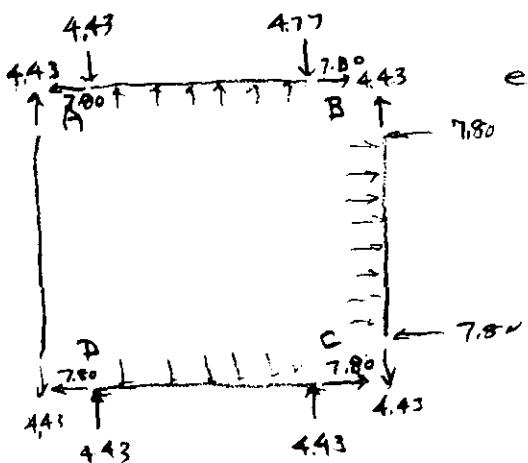
B-52

PROJECT MASS. CHICOPEE FALLS.

SUBJECT OAK ST. PUMPING STA.

PROJECT NO. 6205-2
SHEET NO. 34 OF
DATE MAR. 12, 1983
COMPUTED BY M.A.
CHECKED BY F.N.W.

RING AT ELEV 87° CONSIDERING RING AT EL. 87
WITH AXIAL TENSION.



$$AB \& CD \quad M = 20.9 \quad H = 7.80 \quad END$$

$$e = \frac{12M}{N} + d'' = \frac{12 \times 20.9}{7.80} + 6'' = -26.1 \quad E = -2.17$$

$$K = 160$$

$$F = .121$$

$$NE = (-7.80) \times (-2.17) = 16.9$$

$$KF = 160 \times .121 = 33.6 \quad O.K.$$

$$i = \frac{1}{1 - \frac{.875 \times 14.5}{-26.1}} = \frac{1}{1 + .49} = .67$$

$$A_s = \frac{16.9}{1.44 \times 14.5 \times .67} = 1.20 \quad \# 10 @ 12$$

$$LEFT END$$

$$e = \frac{12 \times 19.1}{-7.80} + 6'' = -29.3 + 6'' = -23.3 \quad E = -1.94$$

$$HE = 1.94 \times 7.80 = 15.1$$

$$i = \frac{1}{1 - \frac{.875 \times 14.5}{-23.3}} = \frac{1}{1 + .55} = .65$$

$$A_s = \frac{15.1}{1.44 \times 14.5 \times .65} = 1.11 \quad \# 10 @ 12$$

MIDDLE

$$e = \frac{12 \times 6.7}{-7.80} - 6'' = -10.4 + 6'' = -4.4 \quad E = .367$$

$$HE = 2.86$$

$$i = \frac{1}{1 - \frac{.875 \times 14.5}{-4.4}} = \frac{1}{1 + 2.88} = .258$$

$$A_s = \frac{2.86}{1.44 \times 14.5 \times .258} = .53 \quad \# 7 @ 12$$

$$DA - ENDS \quad M = 19.0 \quad N = 4.43$$

$$e = \frac{12 \times 19.1}{-4.43} + 6'' = -51.5 + 6'' = -45.5 \quad E = -3.79 \quad NE = 16.75$$

$$i = \frac{1}{1 - \frac{.875 \times 14.5}{-45.5}} = \frac{1}{1 + 2.8} = .78$$

$$A_s = \frac{16.75}{1.44 \times 14.5 \times .78} = 1.03 \quad \# 9 @ 12 \quad O.K.$$

DA - MIDDLE SAME -

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PROJECT MASS., CHICOOEE FALLS.

SUBJECT OAK ST PUMPING STA.

PROJECT NO. 6205-2
SHEET NO. 35 OF
DATE MAR. 12, 1963
COMPUTED BY M.A.
CHECKED BY F.N.W.

RING @ EL. 87 CONSIDERING AXIAL TENS.

C - B

ENDS M = 20.9 N = 4.43 d" = 7 $\frac{1}{2}$ - 2 $\frac{1}{2}$ = 5"

$$e = \frac{12 \times 20.9}{-4.43} + 5" = -56.7 + 5" = -51.7 \quad E = -4.31$$

$$i = \frac{1}{1 - \frac{0.75 \times 12.5}{-51.7}} = \frac{1}{1 + 2.1} = .825 \quad NE = 19.1$$

$$A_s = \frac{19.1}{1.44 \times 12.5 \times .825} = 1.27 \quad \# 10@12 \quad OK$$

MIDDLE M = 17.1 N = 4.43

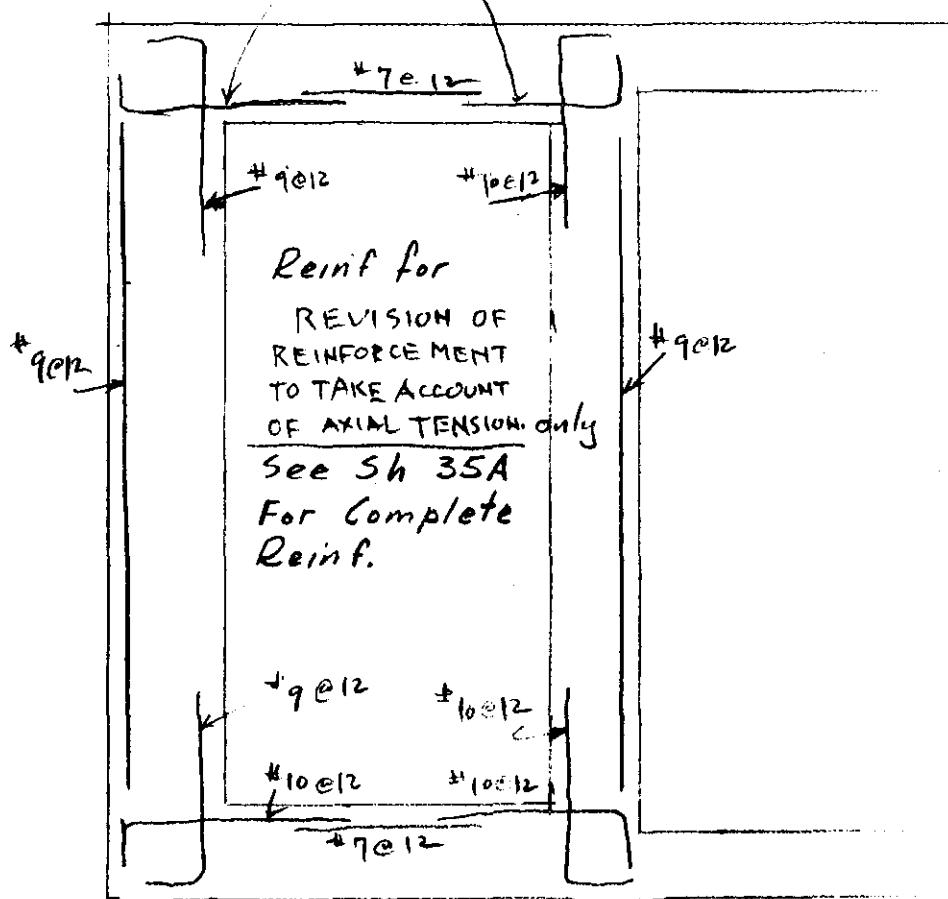
$$e = \frac{12 \times 17.1}{-4.43} + 5" = -46.5 + 5" = -41.5 \quad E = 3.45 \quad NE = 15.3$$

$$i = \frac{1}{1 - \frac{0.75 \times 12.5}{-41.5}} = \frac{1}{1 + 2.6} = .80$$

$$A_s = \frac{15.3}{1.44 \times 12.5 \times .80} = 1.06 \quad \# 9@12 \quad OK.$$

10@12

#



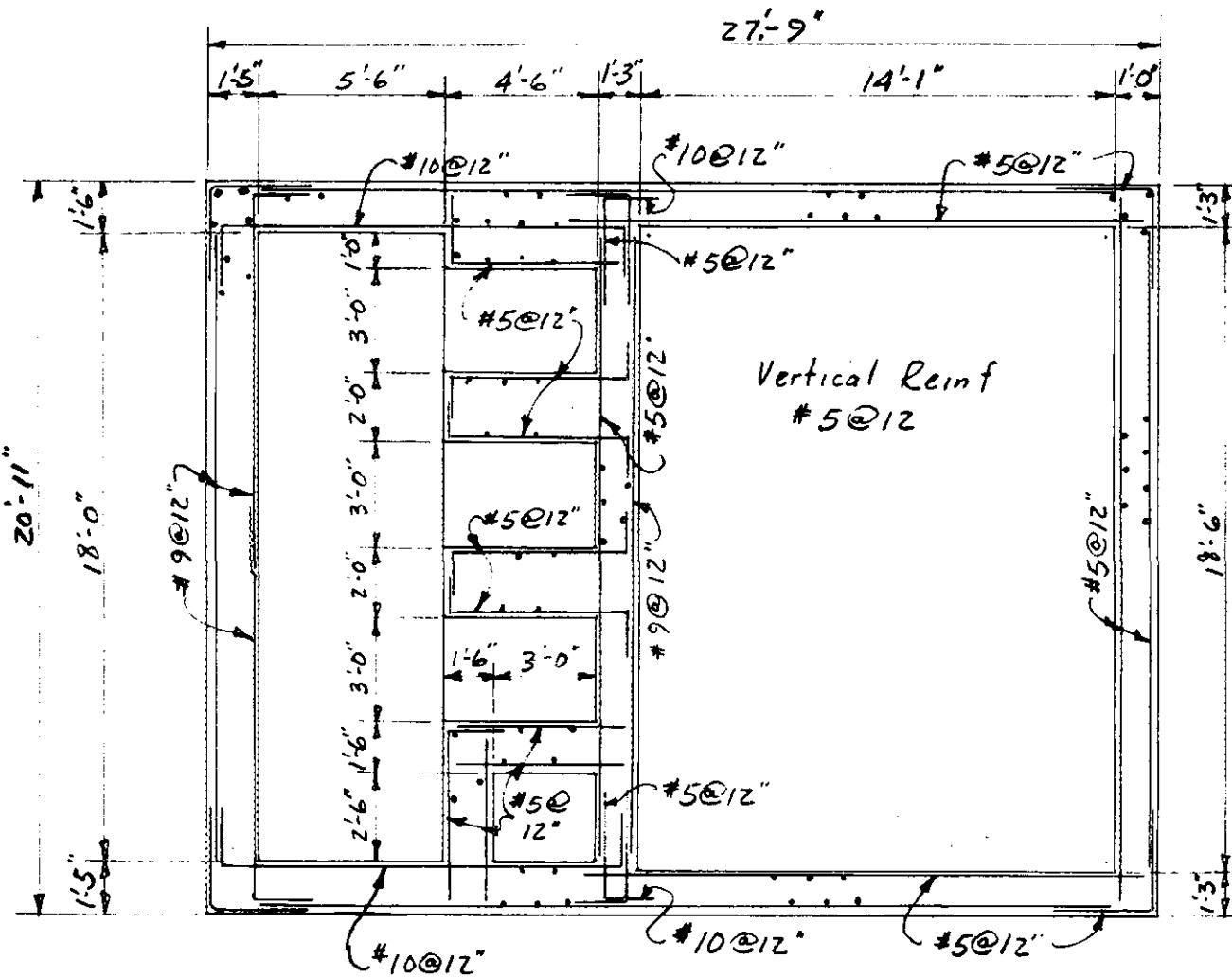
B-54

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PROJECT Chicopee Falls
SUBJECT Pumping Sta. Oak St.

PROJECT NO. 6205
SHEET NO. 35A OF 1
DATE 4/4/63
COMPUTED BY H.A.P.
CHECKED BY H.A.P.



PLAN @ EL. 87.0'+

B-55

PROJECT CHICOPEE FALLS

SUBJECT OAK ST. PUMPING STATION

PROJECT NO. 6205
SHEET NO. 34 OF
DATE Mar. 7, 1963
COMPUTED BY EHW
CHECKED BY ROP

ROOF OVER DISCHARGE BAY

Note: A row of openings prevents the use of two way steel. Run a beam between the stop-log piers.

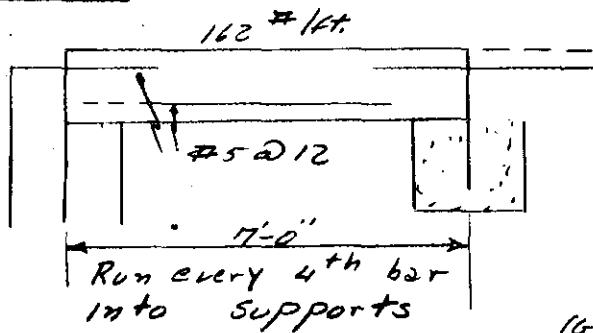
The resulting slab has length ratios of 3:1. One-way steel is mandatory, except for spacers & temp. & shrinkage.

LOADS

Tar & Gravel	6.5
6" slab	75.0
40" snow + 20" gate	60.0
stop logs	20.0
	<u>162.0</u>

$$\text{Cover: } \frac{3}{4} + \frac{d}{2} = 1.0'' \\ d = 6'' - 1'' = 5''$$

SLABS



$$At \# M = 0.162 \times 7^{\frac{3}{8}} = 1.0'k \\ A_s = \frac{40}{1.44 \times 5} = 0.14 \\ \text{Use } \#5 @ 12 = 0.30'' \text{ at supports, neg. steel, } \#5 @ 12 \text{ min.}$$

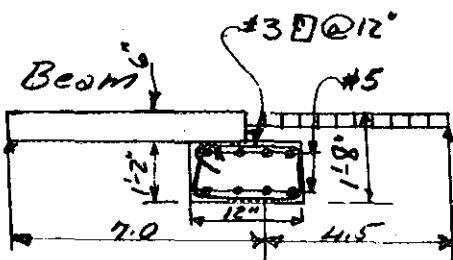
By Using Gate Load as follows:
(Gate Vertical) $\frac{3000}{3.0 \times 5.5} = 180 \text{ #/ft.}$

$$\begin{aligned} T \& G &= 6 \\ \text{slab} &= 7.5 \\ \text{gate} &= 100 \\ \text{lire} &= \frac{50}{311} = 1.6 \end{aligned}$$

$$311(\frac{7.0+4.5}{2}) = 1790$$

$$\text{wt. } \frac{8 \times 6}{144} \times 150 = \frac{50}{1040}$$

$$\text{Span} = 3\frac{1}{2}'' \quad \text{Clear} = 3\frac{1}{7}''$$



$$M = \frac{1}{10} \times 1.840 \times \frac{3.17^2}{2} = 18.5'k$$

$$F = \frac{18.5}{160} = .115 \quad b = 12'' \quad d = 11'' \quad t = 14''$$

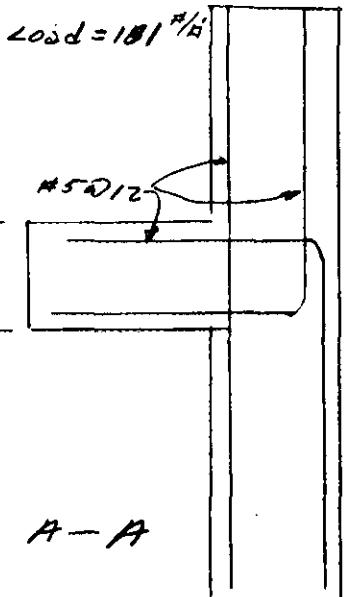
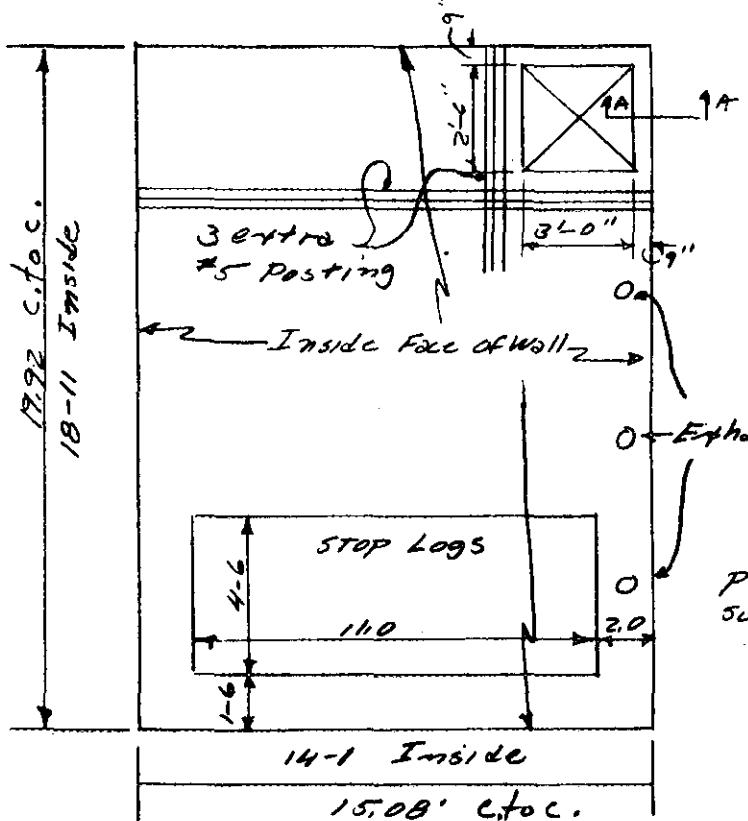
$$A_s = \frac{18.5}{1.44 \times 11} = 1.170'' \quad 4 - \#5 T \& B \quad A_s = 1.240''$$

PROJECT CHICOOPEE FALLS

SUBJECT OAK ST. PUMPING STATION

PROJECT NO. 6205-2
SHEET NO. 37 OF
DATE Mar. 7, 1963
COMPUTED BY F.N.W.
CHECKED BY R.O.P.

ROOF OVER PUMP FLOOR



Note: Every $\frac{1}{4}$ th bar pos. steel extends into supports.
Neg. steel runs to $\frac{1}{4}$ th points

ACI Bldg. Code p. 945

$$M = \frac{15.08}{19.92} = 0.75$$

Short Span $\left\{ \begin{array}{l} \text{Neg.} = C_w s^2 \\ \text{Pos.} \end{array} \right.$

$$0.0518 \times 181 \times 15.08^2 = 2115^{\prime \prime}$$

$$0.0385 \times 181 \times 15.08^2 = 1580^{\prime \prime}$$

Long Span $\left\{ \begin{array}{l} \text{Neg.} \\ \text{pos.} \end{array} \right.$

$$0.033 \times 181 \times 15.08^2 = 1355^{\prime \prime}$$

$$0.025 \times 181 \times 15.08^2 = 1025^{\prime \prime}$$

$$d = \sqrt{\frac{2115 \times 12}{160 \times 12}} = 3.63'' \quad \text{Here } d = 5''$$

$$A_s = \frac{2.115}{144 \times 5} = .294^{\prime \prime}$$

Use #5@12 for pos. & neg.

B-57

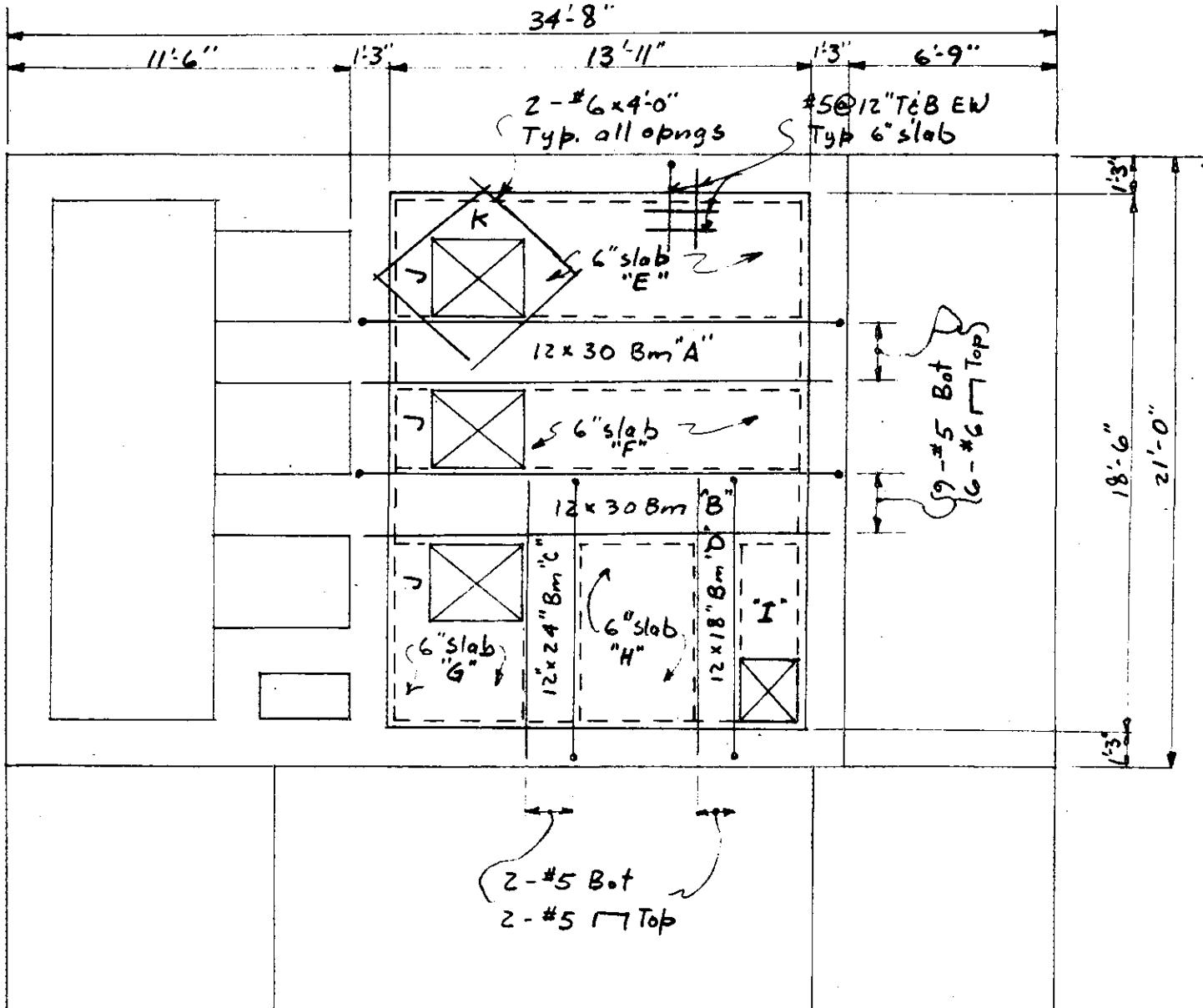
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BOSTON, MASS.

Project Chicopee Falls

Subject Oak St. Pumping Sta.

PROJECT NO. 6205
SHEET NO. 38 OF 1
DATE
COMPUTED BY ENW
CHECKED BY KCP



Plan Operating Floor
EL. 86.06'

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PROJECT CHICOPEE FALLS

SUBJECT OAK ST. PUMPING STATION

PROJECT NO. 6205
 SHEET NO. 39 OF 1
 DATE Mar 11, 1963
 COMPUTED BY ENW
 CHECKED BY ROP

PUMP ROOM FLOOR

BEAMS

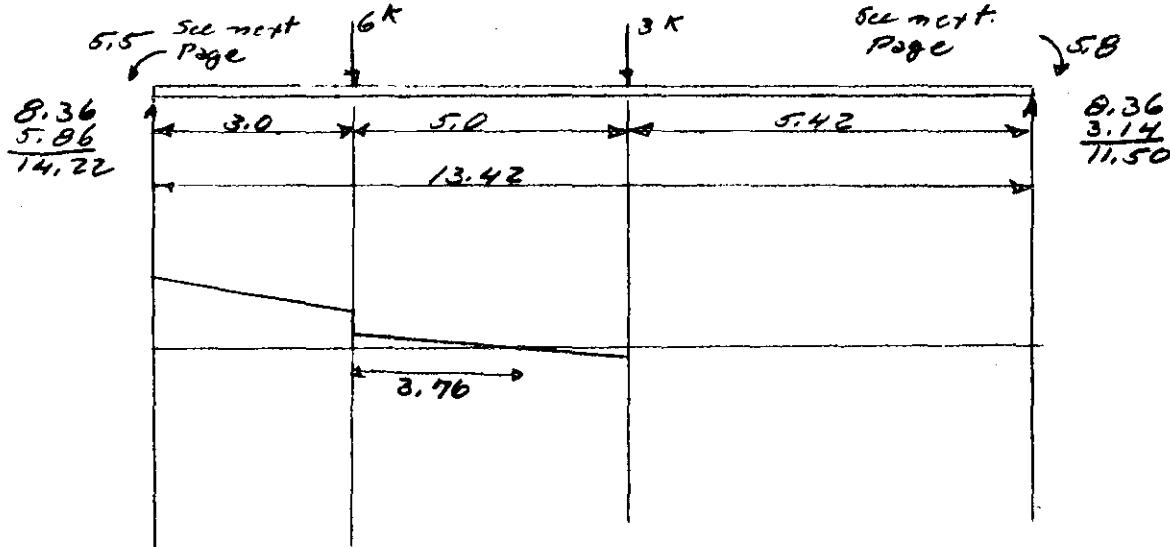
Bms. 5.0' o.c.

Take unit load as $100 + 100 = 200 \text{ kN}$,
 Plus Concre. loads of 6 kN & 3 kN .

Bm "A" is most heavily loaded

Unit load = $200(5/2 + 7.5/2) = 200 \times 6.25 = 125 \text{ kN}$

Compute as simple beam, then allow for
 Fixed ends.



Loads: D.L. $100 \frac{\text{kN}}{\text{m}}$
 L.L. $100 \frac{\text{kN}}{\text{m}}$

+ 3 pump & thrust @ 6

3 prime movers @ 3

+ on slab only

3k over $4' \times 3' = 0.25$

$$M = 14.22 \times 6.76 = 96.0$$

$$- 1.25 \times 6.76^2 / 2 = 28.6 \quad \frac{56.7}{39.3} = M_{\text{at } T_{\text{as}}} \text{ N.m.}$$

$$- 6.0 \times 3.76 = 22.6$$

$$\begin{array}{r} 5.5 \\ \hline M_L & 56.7 \end{array}$$

B-59

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PROJECT CHICOOPEE FALLS

SUBJECT OAK ST. PUMPING STATION

PROJECT NO. 6205-2
SHEET NO. 40 OF _____
DATE Mar 11, 1963
COMPUTED BY FNW
CHECKED BY ROP

PUMP ROOM FLOOR

BEAMS To determine amount of fixed-end moments

$$M_L = P \frac{a^2}{L^2} = 3 \times 6 \times \frac{10.42^2}{13.42^2} = 10.8$$

$$3 \times 8 \times \frac{5.42^2}{13.42^2} = \frac{3.9}{14.7}$$

$$+ 1.25 + \frac{13.42^2}{12} = \frac{18.0}{33.5}$$

$$M_R = P b \frac{a^2}{L^2}$$

$$\text{Unit} = 18.8$$

$$3 \times 5.42 \times \frac{8^2}{13.42^2} = 5.8$$

$$6 \times 10.42 \times \frac{3^2}{13.42^2} = \frac{3.2}{27.8}$$

B-60

PROJECT CHICOPEE FALLS

SUBJECT OAK ST. PUMPING STATION

PROJECT NO. 6205

sheet no. 41 of

DATE MAR 11 1963

COMPUTED BY FHW

CHECKED BY ROP

PUMP ROOM FLOOR

BEAMS. width = 2-6" 2 openings

$$d = \sqrt{\frac{39300 \times 12}{160 \times 72}} = 9.9" + 2.0 = 11.9 = 12.0" \\ d = 10"$$

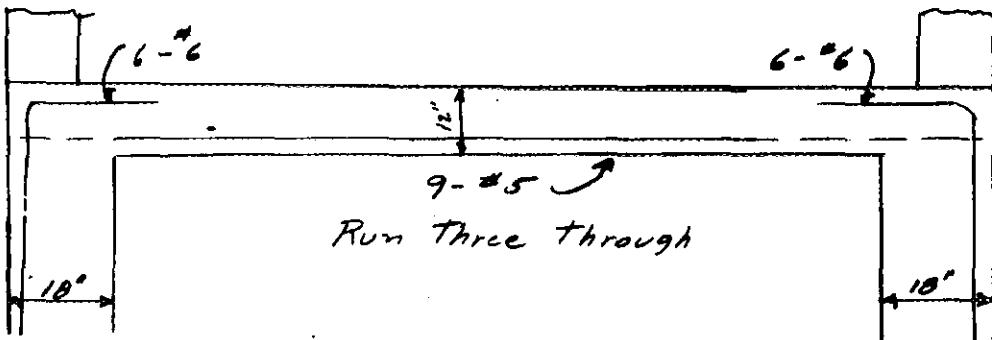
Cover, interior floor beam, $1\frac{1}{2} + \frac{1}{2} = 2"$

Cover, slabs $\frac{3}{4} + \frac{1}{4} = 1.0"$

$$\text{Pos M}_i, A_s = \frac{39.3}{1.44 \times 10} = 2.74" \quad 9 - *5 = 2.79$$

$$V = 14,200 / (30 \times .86 \times 10) = 55 \frac{1}{4}$$

$$w = 200 = 14,200 / (60 \times .86 \times 10) \quad \therefore \Sigma O = 8.2" \\ \text{to provide}$$



$$\text{At ends, } A_s = \frac{33.5}{1.44 \times 10} = 2.34 \quad 6 = *6 = 2.64$$

Effect on Wall of Floor Beam

$$P(wall) = \frac{2.64}{60 \times 14.5} = 0.00304 \quad K = 0.22 \\ j = 0.93$$

$$33,500 \times 12 = \frac{1}{2} f_c (0.22)(0.93) \times 60 \times 14.5^2$$

$$f_c = 310\%$$

$$\text{From bending as ring, } p = \frac{1.0}{18 \times 12} = 0.0046 \quad K = 0.25 \\ j = 0.92$$

$$20,000 \times 12 = \frac{1}{2} f_c (0.25 \times 0.92) 12 \times 14.5^2$$

$f_c = 830\%$ $w = 260$, but there is two way steel

P.S. — the two f_c 's act on diff. sides

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GREEN ENGINEERING AFFILIATES
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PROJECT CHEROKEE FALLS
SUBJECT OAK ST. PUMPING STATION

PROJECT NO. 6205
SHEET NO. A2
DATE Mar 11, 1963
COMPUTED BY EMW
CHECKED BY BOP

PUMP ROOM FLOOR

SLAB

Locl Beam "C"
D. L. = 150

Reg. LL. = 250

Pump, 6.0 = $\frac{500}{12 \text{ lin ft.}} = \frac{500}{900}$

$$M = 0.9 \times \frac{6.25^2}{12} = 2.94 + 2 \times 0.9 \times \frac{6.25}{4} = 2.82$$

M = 5.76, l = 6.0, this section of floor to be 12"

$$A_s = \frac{5.26}{144 \times 10} = 0.4'' \quad \text{Two #5 pos & neg. in this beam} = 0.6''$$

Slab "E" between b.m. "A" and East wall

D. L. = 100

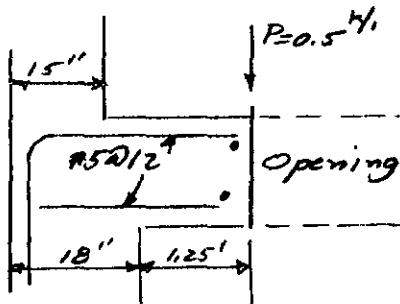
$$\text{Equip LL.} = 250 = 3000/(4 \times 3)$$

$$\text{Reg L.L.} = \frac{100}{450} \text{ #/in} \times \frac{6.25^2}{12} = M = 1.46''$$

$$d = \sqrt{\frac{1460 \times 12}{160 \times 12}} = 3'' \quad \text{use 6" slab } d = 5''$$

$$A_s = \frac{146}{144 \times 5} = 0.2'' \quad \text{use #5 @ 12 min.}$$

Consoles "J"



$$P = \frac{6000}{12} = 500 \text{ #/in}$$

$$\text{wt.} = 0.15 \times \frac{1.25^2}{2} = 0.12 \\ 0.5 \times 1.25 = \frac{0.63}{0.75}$$

$$A_s = \frac{0.75}{144 \times 10} = 0.052 \\ = \text{Negligible}$$

use #5 @ 12

B-62

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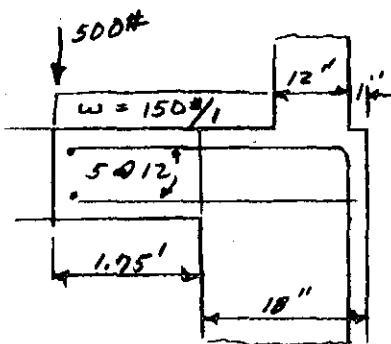
PROJECT CHICOPEE FALLS
SUBJECT OAK ST. PUMPING STATION

PROJECT NO. 6205
SHEET NO. A3 OF 1
DATE MAR 12, 1963
COMPUTED BY EM.W.
CHECKED BY ROP

PUMP ROOM FLOOR

Cantilever "K"

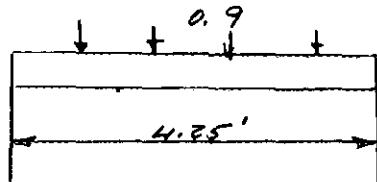
$$M = 0.15 \times 1.75^2 / 2 = 0.23 \\ 0.5 \times 1.75 = 0.88 \\ 1.11$$



$$A_s = \frac{1.11}{1.44 \times 10} = 0.08$$

Use #5 @ 12

Beam D. LOCAL BM.



Using $w = 0.9$ = heavy
 $M = 0.9 \times 4.25^2 / 12 = 1.36$
6" S136 O.K.

$$A_s = \frac{1.36}{1.44 \times 5} = 0.19$$

Use #5 @ 12

No special beam needed

B-63

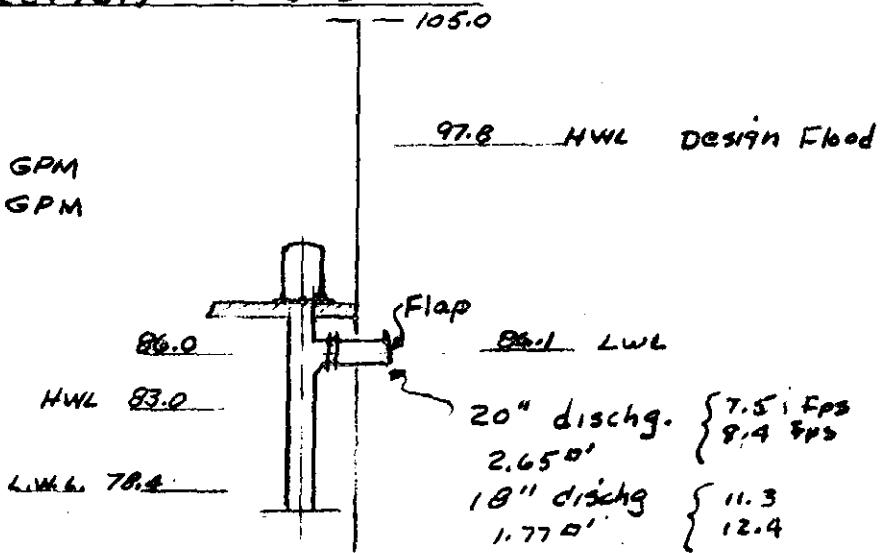
PROJECT CHICOPEE FALLS

SUBJECT Local Protection Project
Pump Selection - MAIN ST

PROJECT NO. 6205-2
SHEET NO. 1 OF 33
DATE 2-14-63
COMPUTED BY JDT
CHECKED BY RDP

MAIN ST.

$Q = HWL \quad 9000 \text{ GPM}$
 $LWL \quad 9900 \text{ GPM}$



dynamic losses - 18" column -	Velocity head -	Low	High
flap - $\frac{1}{2} h_v$.024	.02

Total Head	Low stage	High stage
static	7.7	19.4
dynamic (18")	<u>2.4</u> 10.1'	<u>2.0</u> 21.4'

Use 18" column.

Flap losses from hydraulic design chart 340-1.

$K = 0.01$, from curve

$$H_L = K \frac{V^2}{2g} = 0.01 \times 2.4 = 0.024' \text{ for low head.}$$

$$= 0.01 \times 2.0 = 0.02' \text{ for high head.}$$

Static head at top of local protection - 29.0' ±

C-1

PROJECT NO. 6205-2

SHEET NO. 2 OF 33

DATE 2-25-63

COMPUTED BY ROP

CHECKED BY TDT

PROJECT Chicopee Falls

SUBJECT Local Protection Project

Pump selection - Main St.

Condition #1 head = 10.1 ft $Q_1 = 9900 \text{ GPM} = 22.1 \text{ cfs}$

Condition #2 head = 21.4 ft $Q_2 = 9000 \text{ GPM} = 20.1 \text{ cfs}$

$$\text{*1 Discharge Dia} : \sqrt{\frac{4 \times 22.1 \times 144}{12 \times \pi}} = 18.4''$$

use dia + 218

$$\text{*3 } D_p = D_m \left(\frac{Q_p}{Q_m} \right)^{\frac{1}{2}} = 16 \left(\frac{9900}{10,140} \right)^{\frac{1}{2}} = 15.95'' \text{ use 16" Mixed}$$

$$\text{*4 } Q_m = \frac{Q_p}{\left(\frac{D_p}{D_m} \right)^2} = \frac{9900}{\left(\frac{16.00}{16.00} \right)^2} = 9900 \text{ GPM}$$

$$\text{*5 } H = 8 \text{ ft} \quad Q_x = Q_c \left(\frac{H_x}{H_c} \right)^{\frac{1}{2}} = 9900 \left(\frac{8}{10.1} \right)^{\frac{1}{2}} = 8800 \text{ GPM}$$

$$H = 12 \text{ ft} \quad Q_x = 9900 \left(\frac{12}{10.1} \right)^{\frac{1}{2}} = 10800 \text{ GPM}$$

$$N_c = N_x \left(\frac{Q_c}{Q_x} \right) = 1298 \left(\frac{9900}{10,125} \right) = 1269$$

$$Q_c = Q_x \left(\frac{N_c}{N_x} \right) = Q_x \times \left(\frac{1269}{1298} \right) = Q_x \times .980$$

$$H_c = H_x \left(\frac{N_c}{N_x} \right)^2 = H_x \times \left(\frac{1269}{1298} \right)^2 = H_x \times .960$$

$$P_c = P_x \left(\frac{N_c}{N_x} \right)^3 = P_x \times \left(\frac{1269}{1298} \right)^3 = P_x \times .941$$

H_x	Q_x	P_x	$\frac{H_p}{H_c}$	Q_p	P_p	$E.F.F. = \frac{Q_p H}{3960 P}$
10.0	10150	62	9.6	9950	58	41.5
12.5	10050	64	12.0	9850	60	
15.0	9900	67	14.4	9700	63	56.0
17.5	9700	69	16.8	9500	65	
20.0	9500	72	19.2	9300	68	66.0
22.5	9250	74	21.6	9050	70	70.5
25.0	8975	75	24.0	8800	71	75.0
35.0	7250	77	33.6	7100	72	Max. E.F.F. 83.5

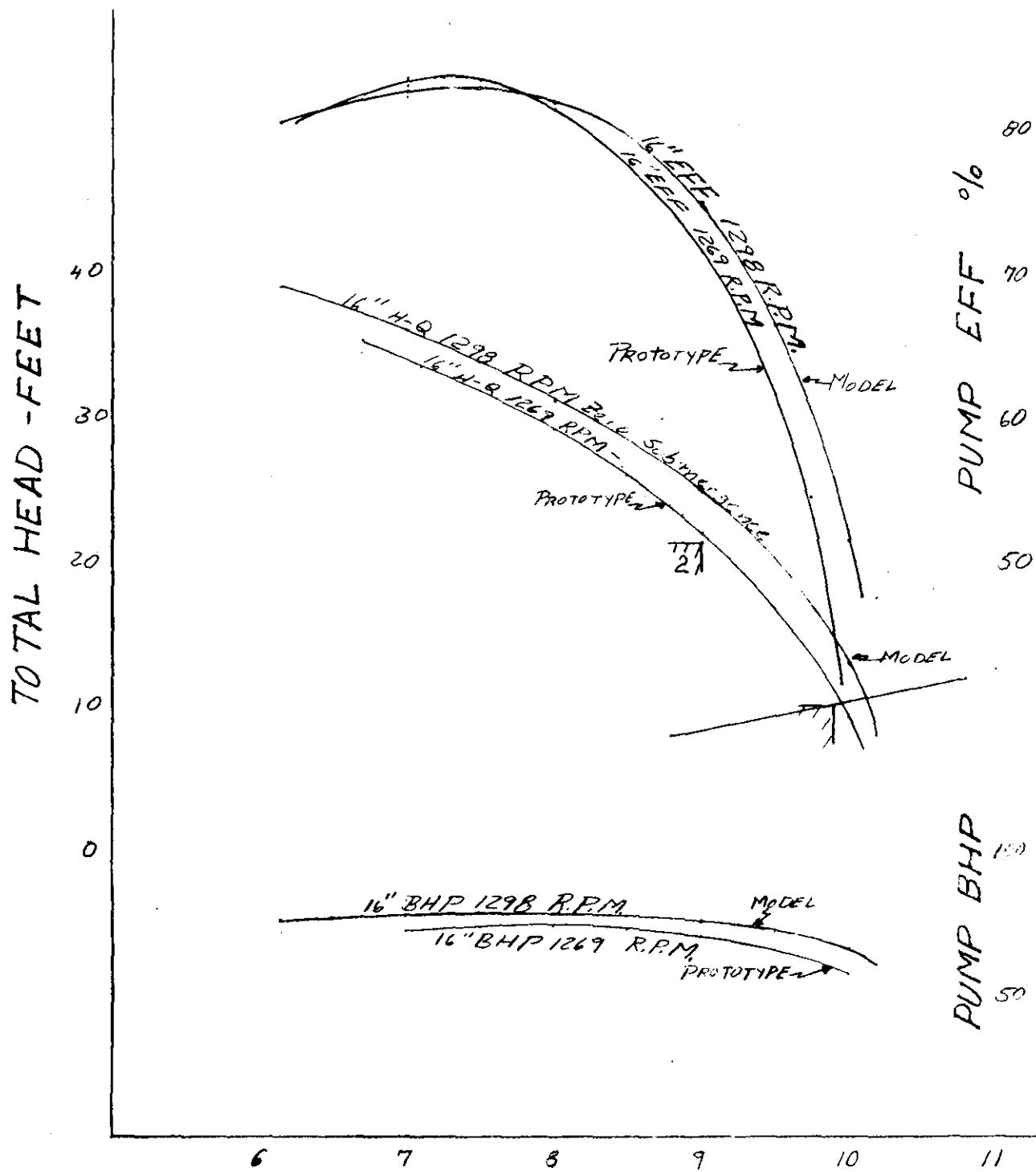
#9 For $H = 33.7$ $N_s = 7725 \therefore$ Suction Lift = 1.4 FT. (Plate #16)

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PROJECT CHICOPEE FALLS

SUBJECT LOCAL PROTECTION PROJECT
PUMP SELECTION - MAIN ST.

PROJECT NO. 6205-2
 SHEET NO. 3 OF 33
 DATE 2-25-63
 COMPUTED BY RAT
 CHECKED BY _____



CAPACITY

TGPM

C-3

REF PLATE #21B
 16" MIXED

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Rev 3-24

PROJECT Chicopee Falls

SUBJECT Local Protection Project
Pump Selection - Main St.

PROJECT NO. 6205-2
 SHEET NO. 4 OF 33
 DATE 2-25-63
 COMPUTED BY R.P.
 CHECKED BY H.D.

Try 18" Pump Mixed Flow $H = 10.1 \quad Q = 9900$

*4 (Thru pt. #1)

$$Q_m = \frac{Q_p}{\left(\frac{D_p}{D_m}\right)^2} = \frac{9900}{\left(\frac{18}{16}\right)^2} = 7830$$

$$H = 10 \text{ ft} \quad Q_x = Q_c \left(\frac{H_x}{H_c}\right)^{\frac{1}{2}} = 7830 \left(\frac{10}{10.1}\right)^{\frac{1}{2}} = 7800$$

$$H = 15.0 \quad Q_x = 7830 \left(\frac{15.0}{10.1}\right)^{\frac{1}{2}} = 9580$$

$$H = 20.0 \quad Q_x = 7830 \left(\frac{20}{10.1}\right)^{\frac{1}{2}} = 11050$$

$$H = 22.5 \quad Q_x = 7830 \left(\frac{22.5}{10.1}\right)^{\frac{1}{2}} = 11750$$

$$N_L = N_x \left(\frac{Q_c}{Q_x}\right) = 1298 \left(\frac{7830}{9850}\right) = 1035$$

$$Q = Q_x \left(\frac{N_c}{N_x}\right) = Q_x \left(\frac{1035}{1298}\right) = .796 Q_x$$

$$H_c = H_x \left(\frac{N_c}{N_x}\right)^2 = H_x \left(\frac{1035}{1298}\right)^2 = .632 H_x$$

$$P_c = P_x \left(\frac{N_c}{N_x}\right)^3 = P_x \left(\frac{1035}{1298}\right)^3 = .505 P_x$$

(See "x" values previous p.)

H_c	Q_c	P_c	H_p	Q_p	P_p	
6.3	8100	31.4	6.3	10,250	40	40.8
7.9	8000	32.3	7.9			
9.5	7880	33.8	9.5	10,000	43	55.8
11.0	7710	34.8	11.0			
12.6	7560	36.4	12.6	9,600	46.3	66.0
14.2	7350	37.4	14.2			
15.8	7120	37.8	15.8	9,080	48.0	75.5
22.1	5780	38.9	22.1	7,330	49.5	82.8
23.7	5200	38.5	23.7	6,600	49.0	80.5

#5

$$H_p = H_m$$

$$Q_p = Q_m \left(\frac{18}{16}\right)^2 = 1.268 Q_m$$

$$P_p = P_m \left(\frac{18}{16}\right)^2 = 1.268 P_m$$

$$N_p = \left(\frac{D_m}{P_p}\right) N_m = \frac{16}{18} \times 1035 = 920$$

C-4

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PROJECT Chicopee Falls

SUBJECT Local Protection Project

Pump Selection - Main St.

PROJECT NO. 6205-3
 SHEET NO. 4 OF _____
 DATE 3-30-63
 COMPUTED BY RD-
 CHECKED BY FBI

#6 H-Q Curve 3H.P. Curve thru Condition Point #2

$$Q_m = Q_p \left(\frac{D_m}{D_p} \right)^2 = 9000 \left(\frac{16}{18} \right)^2 = 7120 \quad 18'' \text{ Mixed Flow}$$

$$H = 21.4 \quad Q = 9000$$

$$Q_x = 7120 \left(\frac{H_x}{H_c} \right)^{\frac{1}{2}}$$

$$H_x = 22.5 \quad Q_x = 7120 \left(\frac{22.5}{21.4} \right)^{\frac{1}{2}} = 8100$$

$$H_x = 32.5 \quad Q_x = 7120 \left(\frac{32.5}{21.4} \right)^{\frac{1}{2}} = 8820$$

$$N_c = 1298 \left(\frac{7120}{8820} \right) = 1103 \text{ RPM}$$

$$Q_c = Q_x \times \left(\frac{1103}{1298} \right) = .85 \quad Q_x$$

$$H_c = H_x \left(\frac{1103}{1298} \right)^2 = .723 H_x$$

$$P_c = P_x \left(\frac{1103}{1298} \right)^3 = .614 P_x$$

H	Q _c	P _c	H _p	Q _p	P _p	EFF.
7.2	9650	38.0	7.2	11,000	48.3	41.4
9.1	8570	39.4	9.1	10,950	50.0	50.
10.8	8400	41.1				
12.7	8250	41.5	12.7	10,450	52.8	64.
14.4	8100	44.2				
16.2	7870	45.5	16.2	10,000	57.8	71
18.0	7610	46.0	18.0	9700	58.5	75
25.3	6180	47.3	25.3	7,850	60.0	83.5
27.1	5580	47.0	27.1	7,100	59.7	81.5

$$H_p = H_m$$

$$N_s = 7725 \quad H = 25.3 \quad 10' \text{ lift}$$

$$Q_p = 1.268 Q_m$$

$$P_p = 1.268 P_m$$

$$N_p = \frac{16}{18} \times 1103 = 982$$

with river

This has unknown capacity at top of protection works - apparently not high except at the top sump level.

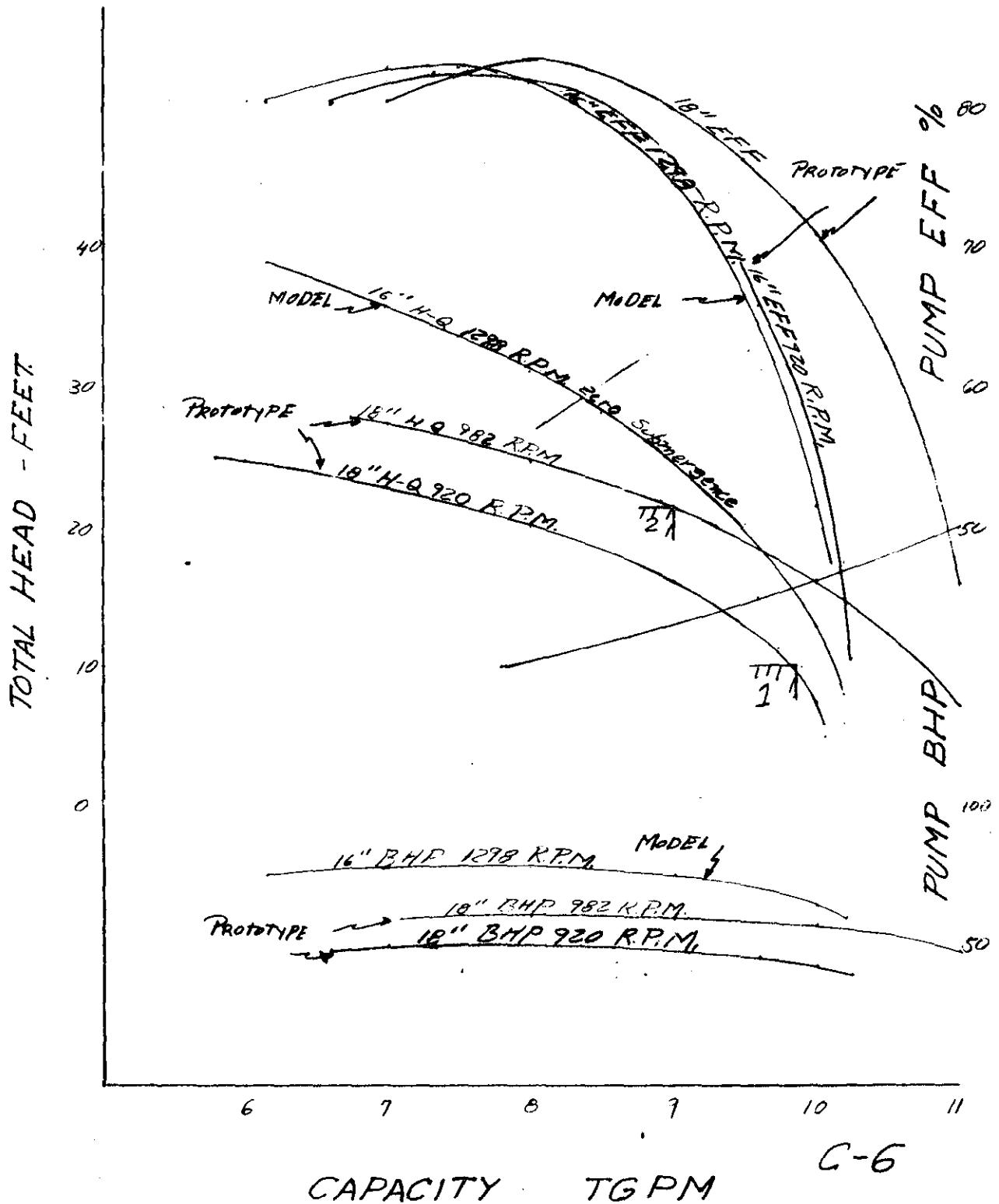
C-5

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PROJECT CHICopee FALLS

SUBJECT LOCAL PROTECTION PROJECT
PUMP SELECTION - MAIN ST.

PROJECT NO. 6205-2
 SHEET NO. 2 OF 2
 DATE 2/26/63
 COMPUTED BY LDP
 CHECKED BY _____



REF PLATE #21B
 18" MIXED

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PROJECT CHICOPEE FALLS
SUBJECT LOCAL PROTECTION PROJECT
PUMP SELECTION - MAIN ST.

PROJECT NO. 6205-2
SHEET NO. 1 OF _____
DATE 3-21-63
COMPUTED BY H.D.H.
CHECKED BY D.L.

From sh. 3A, 18" pump would be controlled at the high head point. This could ultimately shift control partially to a case with water at the top of the wall, $H = 31-32'$ total. It is desirable that significant capacity be available at this head.

To meet this requirement using Plate No 21B would be difficult, and would involve overcapacity at point 1 and probably at point 2, since it would be necessary to design for a point at 31.5' head as a point 3.

Say pt. 3 = 31.5', 5500 gpm

$$Q_m = \frac{5500}{(18/16)^2} = 4350$$

$$\begin{array}{ll} H = 20' & Q_x = 4350 \frac{20}{31.5} = 2760 \\ 40' & Q_x = 4350 \frac{40}{31.5} = 5320 \\ 50' & Q_x = 4350 \frac{50}{31.5} = 6900 \end{array} \quad \left. \begin{array}{l} \text{this is beyond} \\ \text{the curves} \\ \text{Pl. 21B.} \end{array} \right\}$$

Try 31.5', 6000

$$Q_m = \frac{6000}{(18/16)^2} = 4740$$

$$\begin{array}{ll} H = 30' & Q_x = 4740 \frac{30}{31.5} = 4500 \\ H = 40' & Q_x = 4740 \frac{40}{31.5} = 6000 \\ H = 50' & Q_x = 4740 \frac{50}{31.5} = 7500 \end{array} \quad \left. \begin{array}{l} \text{also beyond} \\ \text{curves, Pl. 21B} \end{array} \right\}$$

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PROJECT Chicopee Falls

SUBJECT Local Protection Project
Pump selection, Main St.

PROJECT NO. 6205-2
SHEET NO. 5 OF 1
DATE 3-22-63
COMPUTED BY J.W.H.
CHECKED BY P.C.

20" Mixed-Flow, Curve 21A

Thru pt. #2 - 21.4', 9000 gpm

$$Q_m = \frac{Q_p}{(D_p/D_m)^2} = \frac{9000}{(20/16)^2} = 5760$$

$$H = 20 , Q_x = Q_m \left(\frac{H_x}{H_c} \right)^{1/2} = 5760 \left(\frac{20}{21.4} \right)^{1/2} = 5580$$

$$35 , Q_x = 7360$$

$$40 , Q_x = 7870$$

$$N_c = N_x \left(\frac{Q_c}{Q_x} \right) = \frac{5760}{7525} (1288) = 985 \text{ RPM}$$

$$\frac{P_p}{P_m} = \frac{P_p}{P_m} = \left(\frac{D_p}{D_m} \right)^2 = \left(\frac{20}{16} \right)^2 = 1.56$$

$$P_p = 1.56 Q_c = 1.56 \left(\frac{985}{1288} \right) Q_x = 1.195 Q_x$$

$$H_p = H_c = \left(\frac{960}{1288} \right)^2 H_x = .585 H_x$$

$$P_p = 1.56 Q_c = 1.56 \left(\frac{985}{1288} \right)^3 P_x = .700 P_x$$

$$N_p = \frac{D_m}{D_p} N_m = \frac{16}{20} (985) = 788$$

H_x	Q_x	P_x	H_p	P_p	P_p	EST.
45	5550	80.9	26.3	6640	56.6	78.0
37*	7450	82.5	21.7	8900	57.7	82.1
30	8450	81.0	17.5	10100	56.7	78.7
10	9800	65.0	5.9	11830	45.5	38.8

$N_s = 7400$ $H = 21.7$ 13' lift

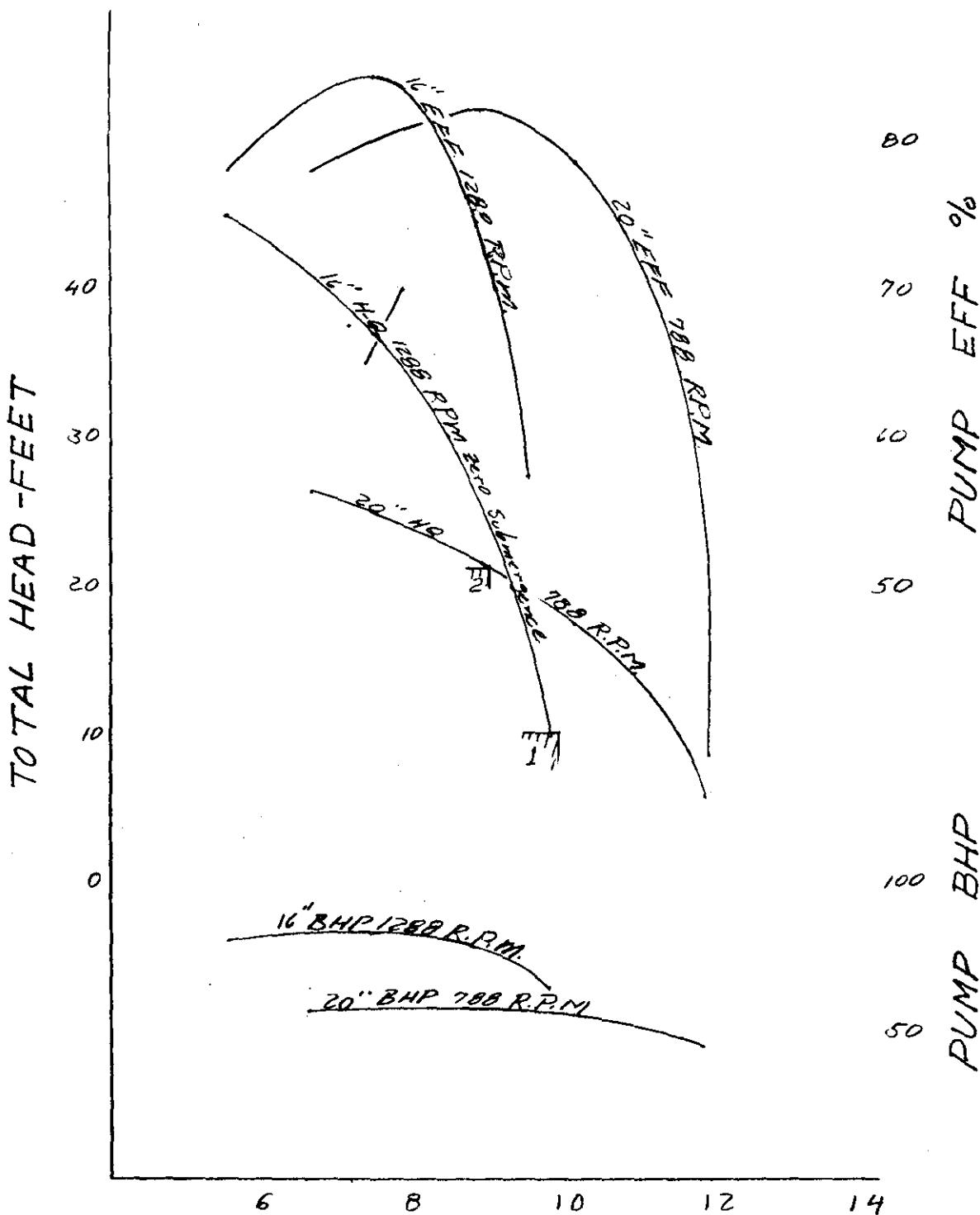
C-8

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PROJECT CHICOPPEE FALLS

SUBJECT Local PROTECTION PROJECT
PUMP SELECTION Main ST.

PROJECT NO. 6205-2
 SHEET NO. OF
 DATE 3/22/63
 COMPUTED BY R.P.P
 CHECKED BY _____



CAPACITY TGPM
 20" Mixed Flow

C-9

REF. PLATE #21A

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PROJECT Chicopee Falls

SUBJECT Local Protection Project
Pump Selection - Main St.

PROJECT NO. G205
 SHEET NO. OF
 DATE 3/22/63
 COMPUTED BY KOP
 CHECKED BY _____

8" Axial Flow Pump - Plate #19

Condition Pl. #1 $H = 10.1$ $Q = 9900$

$$D_p = 20 \left(\frac{9900}{14250} \right)^2 = 16.7 \quad \text{Tuy } 18"$$

$$Q_m = 9900 \left(\frac{20.0}{18.0} \right)^2 = 12230$$

$$H_x = 10.0 \quad Q_x = 12230 \sqrt{\frac{10.0}{10.1}} = 12800$$

$$H_x = 15.0 \quad Q_x = 12230 \sqrt{\frac{15.0}{10.1}} = 14900$$

$$H_x = 12.5 \quad Q_x = 12230 \sqrt{\frac{12.5}{10.1}} = 13600$$

$$N_c = 1037 \times \frac{12230}{13600} = 920$$

$$Q_p = Q_x \times \left(\frac{920}{1037} \right) \left(\frac{18.0}{20.0} \right)^2 = .719 Q_x$$

$$H_p = H_x \times \left(\frac{920}{1037} \right)^2 = .788 H_x$$

$$P_p = P_x \times \left(\frac{920}{1037} \right)^3 \left(\frac{18.0}{20.0} \right)^2 = .567 P_x$$

H_x	Q_x	P_x	$Eff = \frac{Q \times H}{3960 \times P}$
32.5	9500	97.0	
25.25	11650	86.0	
15.25	13500	68.0	
4.00	14900	46.0	

H_p	Q_p	P_p	Eff.
25.6	6830	55.0	80.3
19.9	8380	48.8	86.4 Max
12.0	9720	38.6	76.3
3.2	10710	26.1	33.2

$$N_p = \frac{20}{18} \times 920 = 1021$$

$$N_s = 9930 \quad H = 19.9 \quad 7' lift$$

C-10

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PROJECT NO. 6205

SHEET NO. OF

DATE 3/24/63

COMPUTED BY RCP

CHECKED BY /

PROJECT Chicopee Falls

SUBJECT Local Protection Project

Pump Selection - Main St.

18" Axial Flow Pump - Plate #19

Condition Pf. #2 H = 21.4 Q = 9000

18" Pump

$$Q_m = 9000 \left(\frac{20.0}{18.0} \right)^2 = 11120$$

$$H_x = 25.0 \quad Q_x = 11120 \sqrt{\frac{25.0}{21.4}} = 12000$$

$$H_x = 22.5 \quad Q_x = 11120 \sqrt{\frac{22.5}{21.4}} = 11400$$

$$N_c = 1037 \times \frac{11120}{11800} = 975$$

$$Q_p = Q_x \left(\frac{975}{1037} \right) \times .81 = .763 Q_x$$

$$H_p = H_x \left(\frac{975}{1037} \right)^2 = .887 H_x$$

$$P_p = D_x \left(\frac{975}{1037} \right)^3 \times .81 = .676 P_x$$

H _p	Q _p	P _p	Eff.
28.8	7250	65.5	80.4
22.4	8900	58.2	86.5 Max
13.5	10300	45.9	76.4
3.6	11400	31.1	33.3

$$N_p = \frac{20}{18} \times 975 = 1085$$

C-11

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PROJECT CHICOPEE FALLS

SUBJECT LOCAL PROTECTION PROJECT

PUMP SELECTION - MAIN ST.

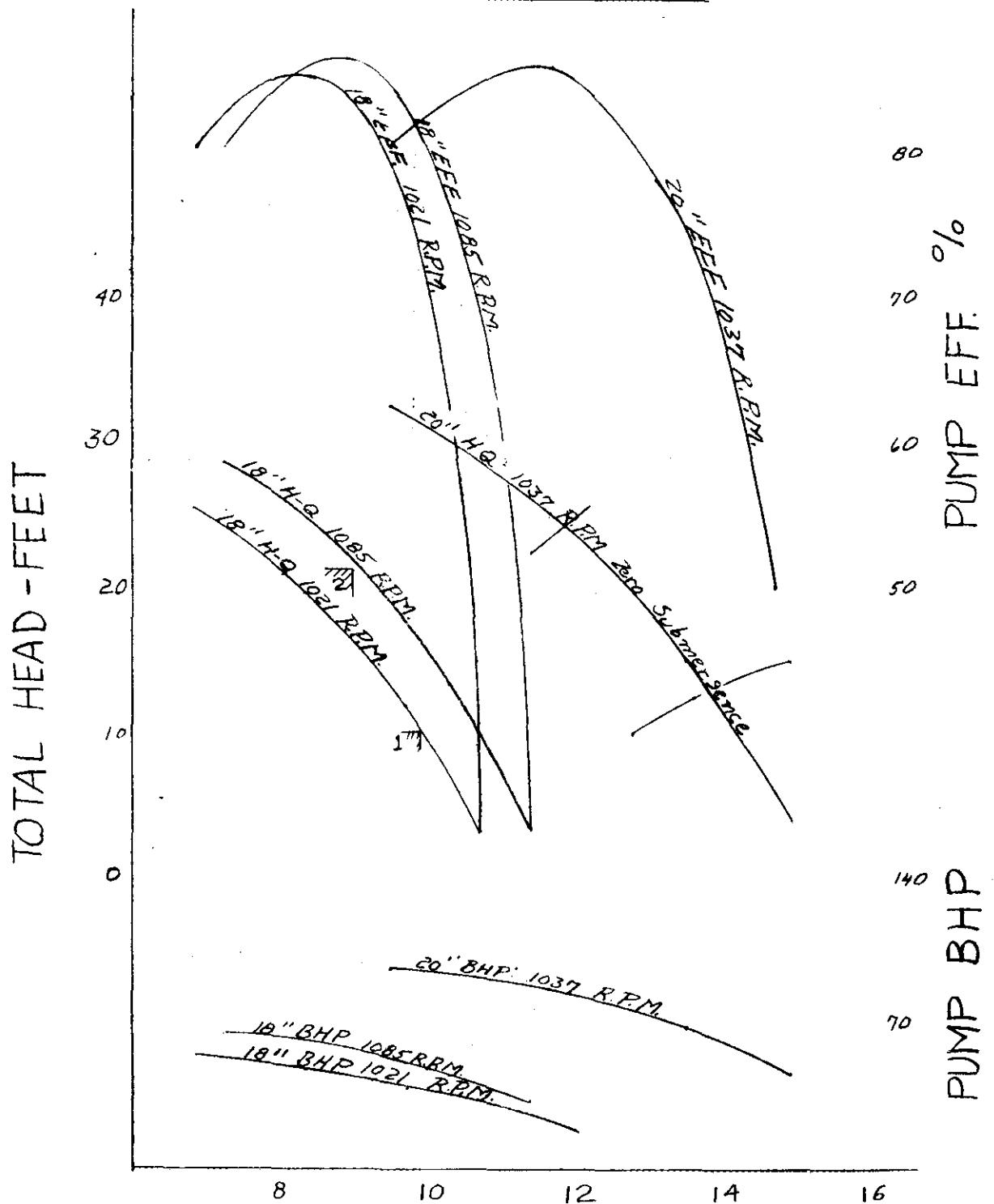
PROJECT NO. 6205-2

SHEET NO. 0 OF 1

DATE 3/26/63

COMPUTED BY D.P.

CHECKED BY _____



CAPACITY
18" Axial Flow

TGPM
C-12

REF. PLATE #19

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PROJECT Chicopee Falls

SUBJECT Local Protection Project
Pump Selection - Main St.

PROJECT NO. 6205
 SHEET NO. OF
 DATE 3/22/63
 COMPUTED BY JTP
 CHECKED BY JP

20" Axial Flow Pump Plate #19

Condition Pt. #2 H = 21.4' Q = 9000 20" Pump

$$Q_m = 9000 \left(\frac{20.0}{20.0} \right)^2 = 9000$$

$$H_x = 27.5 \quad Q_x = 9000 \left(\frac{27.5}{21.4} \right)^2 = 10200$$

$$H_x = 30.0 \quad Q_x = 9000 \left(\frac{30.0}{21.4} \right)^2 = 10650$$

$$N_c = 1037 \quad \frac{9000}{10650} = 885$$

$$Q_p = Q_x \left(\frac{885}{1037} \right) \left(\frac{20.0}{20.0} \right)^2 = .853 Q_x$$

$$H_p = H_x \left(\frac{885}{1037} \right)^2 = .727 H_x$$

$$P_p = P_x \left(\frac{885}{1037} \right)^3 \left(\frac{20.0}{20.0} \right)^2 = .621 P_x$$

H _x	Q _x	P _x
32.5	9500	97.0
25.25	11650	86.0
15.25	13500	68.0
4.0	14900	46.0

H _p	Q _p	P _p	Eff.
23.6	8100	60.2	80.2
18.4	9950	54.5	84.8 Max
11.1	11530	42.2	76.5
2.9	12710	28.6	32.6

$$N_p = 885$$

$$N_s = 9930 \quad H = 18.4 \quad 8' lift$$

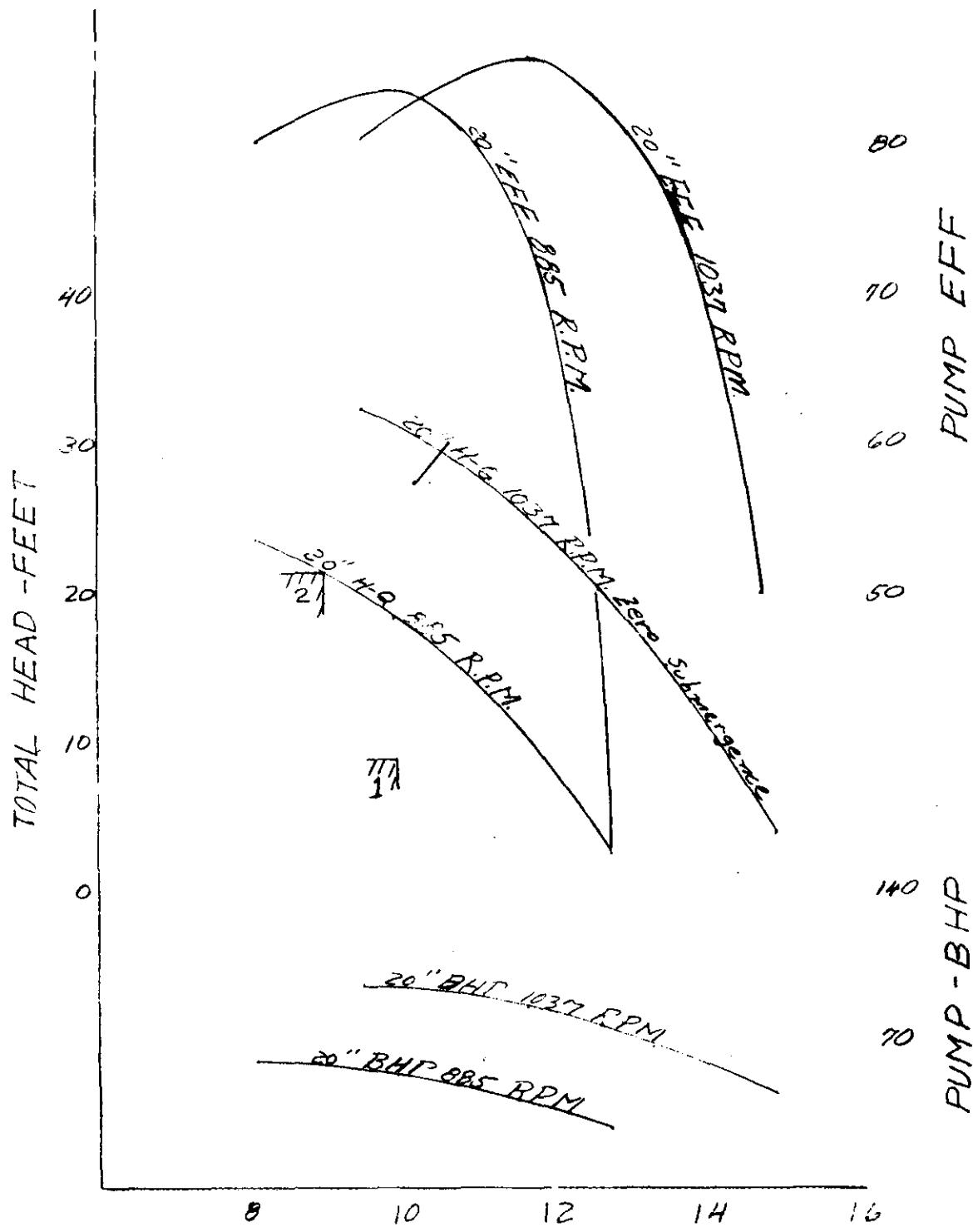
C-13

GREEN ENGINEERING AFFILIATES
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 BOSTON, MASS.

PROJECT CHICOPEE FALLS

SUBJECT LOCAL PROTECTION PROJECT
PUMP SELECTION - MAIN ST.

PROJECT NO. 6205-2
 SHEET NO. OF
 DATE 3/22/63
 COMPUTED BY POP
 CHECKED BY _____



TGPM

C-14

REF. PLATE #19

GREEN ENGINEERING AFFILIATES
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PROJECT Chicopee Falls

SUBJECT Local Protection Project

Pump Selection - Main St.

22" Axial Flow Pump - Plate #19

Conditions Pt. #2 $H = 21.4$ $Q = 9000$

PROJECT NO. 6205-2
 SHEET NO. OF
 DATE 3-26-63
 COMPUTED BY POP
 CHECKED BY TBT

$$Q_m = 9000 \left(\frac{20.0}{22.0} \right)^2 = 7440$$

$$H_x = 32.5 \quad Q_x = 7440 \left(\frac{32.5}{21.4} \right)^{\frac{1}{2}} = 9170$$

$$H_x = 30.0 \quad Q_x = 7440 \left(\frac{30.0}{21.4} \right)^{\frac{1}{2}} = 8820$$

Note: The line of constant specific speed lies beyond the limits of the H-Q Curve. A pump can not be selected on this basis without extrapolating from the H-Q curves.

No further selection will be attempted.

C-15

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BOSTON, MASS.

PROJECT NO. 6205-C

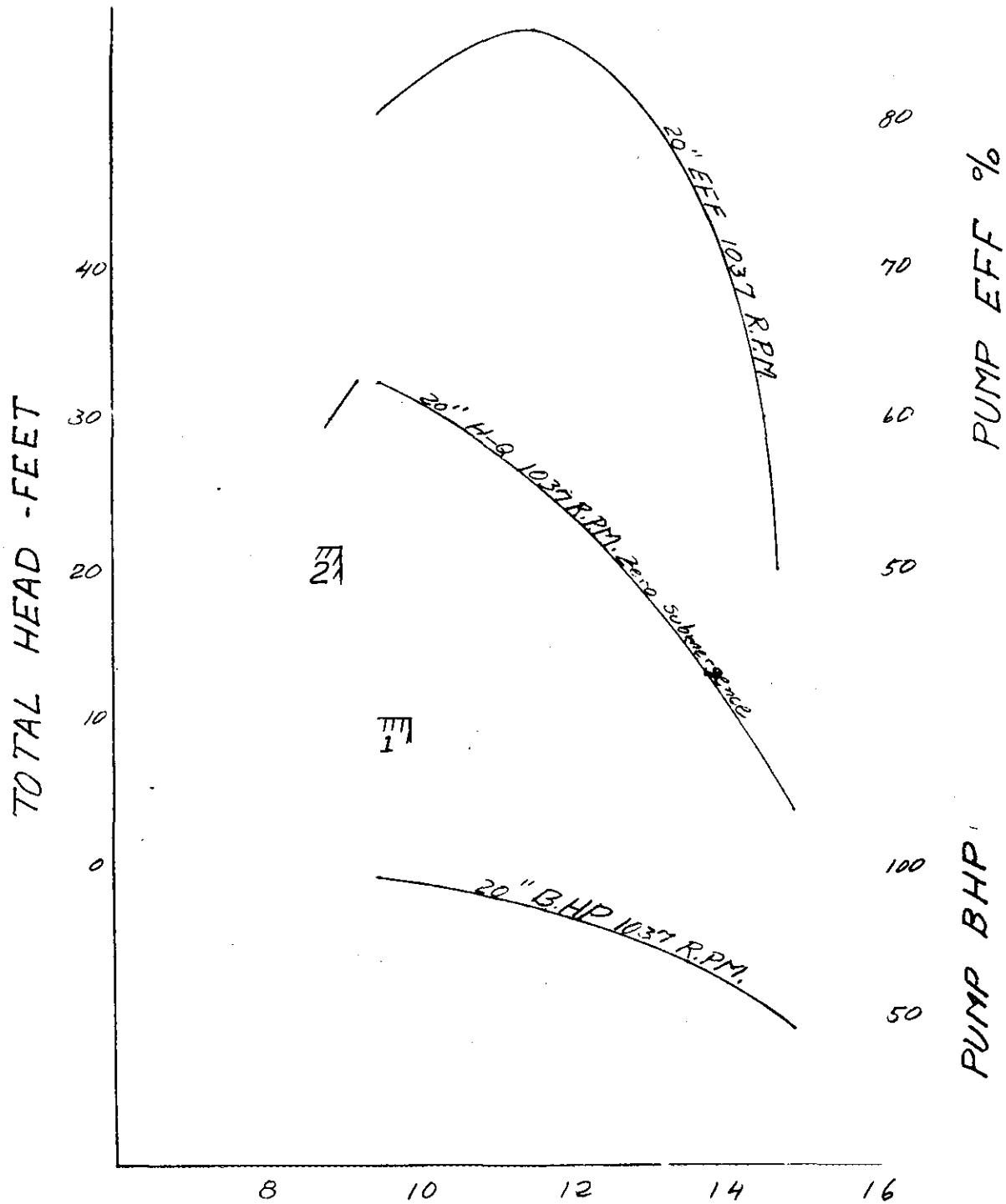
SHEET NO. OF

DATE 3/26/63

COMPUTED BY RCP

CHECKED BY

PROJECT CHICOREE FALLS
SUBJECT LOCAL PROTECTION
PUMP SELECTION-MAIN ST.



CAPACITY

TGPM

C-16

REF. PLATE #19

GREEN ENGINEERING AFFILIATES

BOSTON, MASS.

PROJECT Chicopee Falls

SUBJECT Social Preference Project

Year Selection = No. 11 St.

PROJECT NO. 6205
SHEET NO. 1 OF 1

DATE 3/20/63

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GREEN ENGINEERING AFFILIATES
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PROJECT CHICOPEE FALLS

SUBJECT Local Protection Project
Pump Selection - OAK ST.

PROJECT NO. 6205-Z
 SHEET NO. 6 OF _____
 DATE 2-19-63
 COMPUTED BY MM
 CHECKED BY POP

OAK ST.

Q - H.W.L. 7000 gpm
 L.W.L. 8600 "

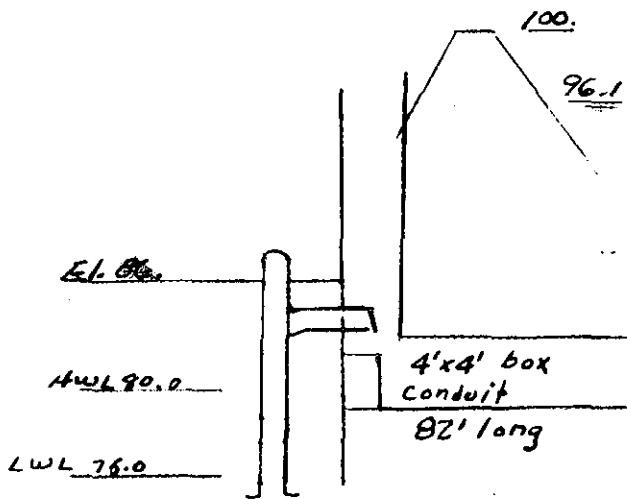
Static Heads

H.W.L. - 21.1
 L.W.L. - 7.0

Project Design Elev.

H.W.L. = 96'

L.W.L. = 82'



16" col., V = 13.5 Fps, L.W.L.

11.1 Fps, H.W.L.

Conduit velocity, 3 pumps -

2.9 Fps H.W.L.

3.55 Fps L.W.L.

{size set for bypass)
 gravity flow

$$TDH = \text{static} + H_{col} + .01 H_{col} + H_v_{\text{conduit}} + \frac{1}{2} H_v_{\text{conduit}} \\ (\text{flap}) \quad (\text{disch. chamber}) \\ + H_f_{\text{conduit}}$$

C-18

GREEN ENGINEERING AFFILIATES
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PROJECT Chicopee Falls

SUBJECT Local Protection Project
Pump Selection - Oak st.

PROJECT NO. 6205-2
 SHEET NO. 7 OF 8
 DATE 2-26-63
 COMPUTED BY RAP
 CHECKED BY HDM

Condition #1

$$\begin{aligned} \text{static head} &= 7.0 \\ \text{Col } H_v &= \frac{13.5}{2g} = 2.83 \\ \text{Flap } H_v &= .01 \times \frac{13.5}{2g} = 0.03 \\ \text{Conduit } H_v &= \frac{3.55^2}{2g} = 0.20 \\ \text{Ent. Disch. Chamber} &= \frac{1}{2} \frac{3.55^2}{2g} = 0.10 \\ \text{Conduit } H_f &= 2.87 \times (0.013) \times \frac{82 \times 3.55^2}{4.52^{4/3}} = \frac{0.67}{10.83} \end{aligned}$$

$$TDH = 10.8'$$

Condition #2

$$\begin{aligned} \text{static Head} &= 21.10 \\ \text{Col } H_v &= \frac{17.1}{2g} = 1.93 \\ \text{Flap } H_v &= .01 \frac{17.1}{2g} = 0.02 \\ \text{Conduit } H_v &= \frac{2.9^2}{2g} = 0.13 \\ \text{Ent. Disch. Chamber} &= \frac{1}{2} \frac{2.9^2}{2g} = 0.07 \\ \text{Conduit } H_f &= 2.87 \times (0.013) \times \frac{82 \times 2.9^2}{4.52^{4/3}} = \frac{0.28}{23.53} \end{aligned}$$

$$TDH = 23.5'$$

Note: Revising Flap valve losses & pump col size increased TDH, ea. cond., by only $\frac{1}{10}$ of a foot.
 Changes on subsequent sheets not made because changes are insignificant for preliminary pump selection

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PROJECT NO. 6205
SHEET NO. 8 OF 1
DATE Feb 25, 1963
COMPUTED BY LTP
CHECKED BY PA

PROJECT Chicopee Falls

SUBJECT Local Protection Project

Pump Selection - Oak St.

Try 16" Pump - Plate 21C Mixed

#1

$$\text{Discharge Dia.} = \sqrt{\frac{4 \times 17.6 \times 144}{12\pi}} = 16.4"$$

#2

$$\begin{aligned} \text{Condition, #1} \quad H_1 &= 10.8' \quad Q_1 = 8600 \text{ GPM} \\ H_2 &= 23.5' \quad Q_2 = 7000 \text{ GPM} \end{aligned}$$

#3

$$D_p = D_m \left(\frac{Q_p}{Q_m} \right)^{\frac{1}{2}} = 16 \left(\frac{8600}{9425} \right)^{\frac{1}{2}} = 15.30" \quad \text{Use 16" Pump}$$

#4

$$Q_m : \frac{Q_p}{\left(\frac{D_p}{D_m} \right)^2} : \frac{8600}{\left(\frac{16}{16} \right)^2} = 8600$$

$$Q_x = Q_c \left(\frac{H_x}{H_c} \right)^{\frac{1}{2}}$$

$$\text{for } H_x = 10.0 \quad Q_x = 8600 \left(\frac{10.0}{10.7} \right)^{\frac{1}{2}} = 8310$$

$$H_x = 12.5 \quad Q_x = 8600 \left(\frac{12.5}{10.7} \right)^{\frac{1}{2}} = 9290$$

$$H_x = 15.0 \quad Q_x = 8600 \left(\frac{15.0}{10.7} \right)^{\frac{1}{2}} = 10200$$

$$N_c = N_x \left(\frac{Q_c}{Q_x} \right) = 1378 \left(\frac{8600}{9290} \right) = 1278$$

$$Q_c = C_x \left(\frac{N_c}{N_x} \right) \cdot Q_x \left(\frac{1278}{1378} \right) = .927 Q_x$$

$$H_c = H_x \left(\frac{N_c}{N_x} \right)^2 = H_x \left(\frac{1278}{1378} \right)^2 = .859 H_x$$

$$P_c = P_x \left(\frac{N_c}{N_x} \right)^3 = P_x \left(\frac{1278}{1378} \right)^3 = .796 P_x$$

H_x	Q_x	P_x	H_c	Q_c	P_c	EFF.
44.5	4750	68.5	38.2	4400	54.5	77.8
36.0	6650	68.5	30.9	6160	54.5	Max. 88.3
25.0	8075	63.5	21.5	7480	50.5	80.4
10.0	9475	53.5	8.6	8780	42.6	44.8

$$N_p = 1278$$

$$N_p = 7650 \quad H = 30.9 \quad \text{Submergence} = 5.0' / \text{ft.}$$

C-20

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17

PROJECT CHICOPEE FALLS

SUBJECT LOCAL PROTECTION PROJECT
PUMP SELECTION - OAK ST.

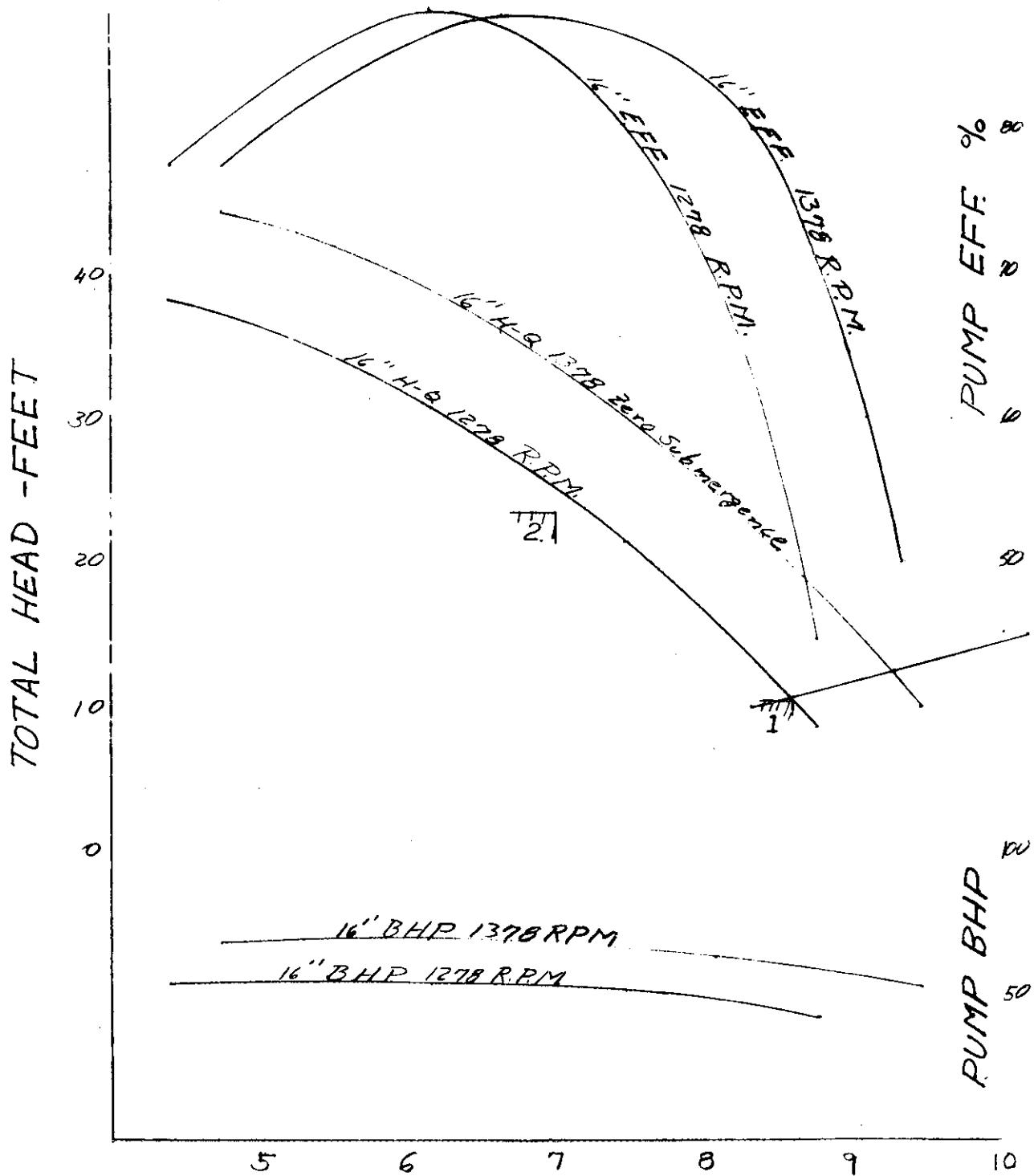
PROJECT NO. 6225-2

SHEET NO. 1 OF

DATE 2/26/63

COMPUTED BY ROP

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16" Mixed

CAPACITY TGPM

C-21

REF. PLATE #21C

GREEN ENGINEERING AFFILIATES
 ENGINEERS
 BOSTON, MASS.

PROJECT Chicopee Falls

SUBJECT Local Protection Project
Pump Selection - Oak St.

Try 18" pump - Plate 21C Pt. #1 H = 10.8' Q = 8600

*4

$$Q_m = Q_p \left(\frac{D_m}{D_p} \right)^2 = 8600 \left(\frac{16}{18} \right)^2 = 6790$$

$$Q_x = Q_c \left(\frac{H_x}{H_c} \right)^{\frac{1}{2}}$$

$$H_x = 17.5 \quad Q_x = 6790 \left(\frac{17.5}{10.7} \right)^{\frac{1}{2}} = 8800$$

$$H_x = 20.0 \quad Q_x = 6790 \left(\frac{20.0}{10.7} \right)^{\frac{1}{2}} = 9290$$

$$N_c = N_x \left(\frac{Q_c}{Q_x} \right) = 1378 \left(\frac{6790}{8850} \right) = 1058$$

$$Q_p = Q_x \left(\frac{N_c}{N_x} \right) \left(\frac{D_p}{D_m} \right)^2 = \left(\frac{1058}{1378} \right) \left(\frac{18.0}{16.0} \right)^2 Q_x = .971 Q_x$$

$$H_p = H_x \left(\frac{N_c}{N_x} \right)^2 = \left(\frac{1058}{1378} \right)^2 H_x = .588 H_x$$

$$P_p = P_x \left(\frac{N_c}{N_x} \right)^3 \left(\frac{D_p}{D_m} \right)^2 = \left(\frac{1058}{1378} \right)^3 \left(\frac{18.0}{16.0} \right)^2 P_x = .572 P_x$$

H _p	Q _p	P _p	EFF.
26.2	4610	39.2	78.8
21.2	6470	39.2	88.4 Max.
14.7	7840	36.3	80.2
5.9	9200	30.3	45.2

$$N_p = 1058 \left(\frac{16.0}{18.0} \right) = 939$$

$$N_s = 7650 \quad H = 21.2 \quad \text{Submergence} = 13 \text{ ft. lift.}$$

C-22

GREEN ENGINEERING AFFILIATES
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PROJECT Chicopee Falls

SUBJECT Local Protection Project

Pump Selection - Oak St.

18" Pump R 21C Pt. #2 H = 23.5 Q = 7000

#6

$$Q_m = 7000 \left(\frac{16}{18}\right)^2 = 5530$$

$$Q_x = Q_c \left(\frac{H_x}{H_c}\right)^2$$

$$H_x = 37.5 \quad Q_x = 5530 \left(\frac{37.5}{23.4}\right)^{\frac{1}{2}} = 7000$$

$$H_x = 35.0 \quad Q_x = 5530 \left(\frac{35.0}{23.4}\right)^{\frac{1}{2}} = 6770$$

$$N_c = N_x \left(\frac{Q_x}{Q_c}\right) = 1378 \left(\frac{5530}{6770}\right) = 1125$$

$$Q_p = Q_x \left(\frac{N_c}{N_x}\right) \left(\frac{D_p}{D_m}\right)^2 = Q_x \left(\frac{1125}{1378}\right) \left(\frac{18.0}{16.0}\right)^2 = 1.035 Q_x$$

$$H_p = H_x \left(\frac{N_c}{N_x}\right)^2 = H_x \left(\frac{1125}{1378}\right)^2 = .648 H_x$$

$$P_p = P_x \left(\frac{N_c}{N_x}\right)^3 \left(\frac{D_p}{D_m}\right)^2 = P_x \left(\frac{1125}{1378}\right)^3 \left(\frac{18.0}{16.0}\right)^2 = .691 P_x$$

H_p	G_p	P_p	EFF.	$EFF = \frac{H_p Q_p}{P_p \times 3960}$
29.7	4920	47.3	78.0	
24.2	6890	47.3	89.0 Max	
16.7	8360	43.8	80.5	
6.7	9810	36.9	45.0	

$$N_p = \frac{16}{18} 1125 = 1000$$

$$N_s = 7650 \quad H = 24.2 \quad \text{Submergence} = 11' \text{ lift}$$

C-23

PROJECT NO. 6205

SHEET NO. 11 OF 1

DATE 27-63

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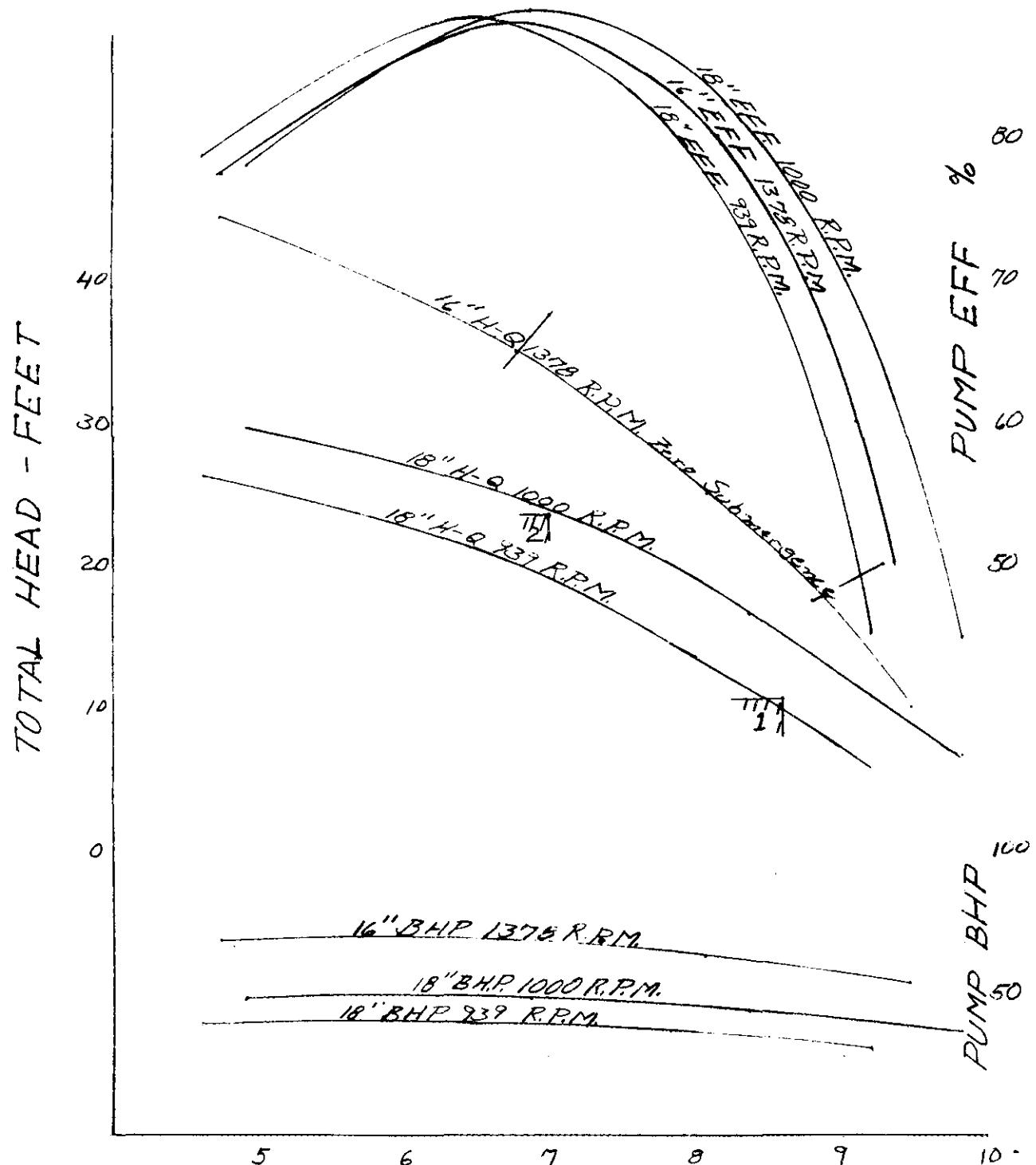
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PROJECT CHEROKEE FALLS

SUBJECT LOCAL PROTECTION PROJECT
PUMP SELECTION - OAK ST

PROJECT NO. 6205-2
SHEET NO. OF
DATE 2/27/63
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CAPACITY TGPM

18" Mixed

C-24

REF. PLATE #21C

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PROJECT Chicopee Falls

SUBJECT Local Protection Project
Pump Selection - Oak st

PROJECT NO. 6205
 SHEET NO. 1 OF 1
 DATE 3/26/63
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Try 20" Mixed Flow $H = 10.8$ $Q = 8600$ PF^H

$$\#4 \quad Q_m = Q_p \left(\frac{D_m}{D_p} \right)^2 = 8600 \left(\frac{16.0}{20.0} \right)^2 = 5500$$

$$Q_x = Q_c \left(\frac{H_x}{H_c} \right)^{\frac{1}{2}}$$

$$H_x = 25.0 \quad Q_x = 5500 \sqrt{\frac{25.0}{10.8}} = 8360$$

$$H_x = 22.5 \quad Q_x = 5500 \sqrt{\frac{22.5}{10.8}} = 7940$$

$$N_c = N_x \left(\frac{Q_c}{Q_x} \right) = 1378 \left(\frac{5500}{8175} \right) = 926$$

$$Q_p = Q_x \left(\frac{N_c}{N_x} \right) \left(\frac{D_p}{D_m} \right)^2 = Q_x \left(\frac{926}{1378} \right) \left(\frac{20.0}{16.0} \right)^2 = 1.052 Q_x$$

$$H_p = H_x \left(\frac{N_c}{N_x} \right)^2 = H_x \left(\frac{926}{1378} \right)^2 = .453 H_x$$

$$P_p = P_x \left(\frac{N_c}{N_x} \right)^3 \left(\frac{D_p}{D_m} \right)^2 = P_x \left(\frac{926}{1378} \right)^3 \left(\frac{20.0}{16.0} \right)^2 = .476 P_x$$

H_x	Q_x	P_x	$EFF = \frac{Q \times H}{3960 \times P}$
44.50	1750	69.0	
36.00	6650	69.0	
25.75	8000	64.0	
10.00	9475	54.0	

H_p	Q_p	P_p	Eff.
20.2	5000	32.8	78
16.3	7000	32.8	88 <i>Best</i>
11.7	8420	30.4	82
4.5	9975	25.6	44

$$N_p = \frac{16}{20} \times 926 = 742$$

C-25

GREEN ENGINEERING AFFILIATES
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PROJECT Chicopee Falls

SUBJECT Local Protection Project
Pump Selection - Oak St.

20" Mixed Flow $H = 23.5$ $Q = 7000$ Pt #2

$$*6 \quad Q_m = 7000 \left(\frac{16.0}{20.0} \right)^2 = 4480$$

$$H_x = 42.5 \quad Q_x = 4480 \sqrt{\frac{42.5}{23.5}} = 6025$$

$$H_x = 40.0 \quad Q_x = 4480 \sqrt{\frac{40.0}{23.5}} = 5850$$

$$N_c = 1378 \left(\frac{4480}{5850} \right) = 1055$$

$$Q_p = \left(\frac{1055}{1378} \right) \left(\frac{20.0}{16.0} \right)^2 Q_x = 1.197 Q_x$$

$$H_p = \left(\frac{1055}{1378} \right)^2 H_x = .586 H_x$$

$$P_p = \left(\frac{1055}{1378} \right)^2 \left(\frac{20.0}{16.0} \right)^2 P_x = .702 P_x$$

H_p	Q_p	P_p	EFF.
26.1	5680	48.4	77.4
21.1	7960	48.4	87.6 Max.
15.1	9575	44.9	81.3
5.9	11350	37.9	44.6

$$N_p = \frac{16}{20} \times 1055 = 845$$

$$N_s = 7650 \quad H = 21.1 \quad 14' lift$$

PROJECT NO. i-205

SHEET NO. OF

DATE 3/26/63

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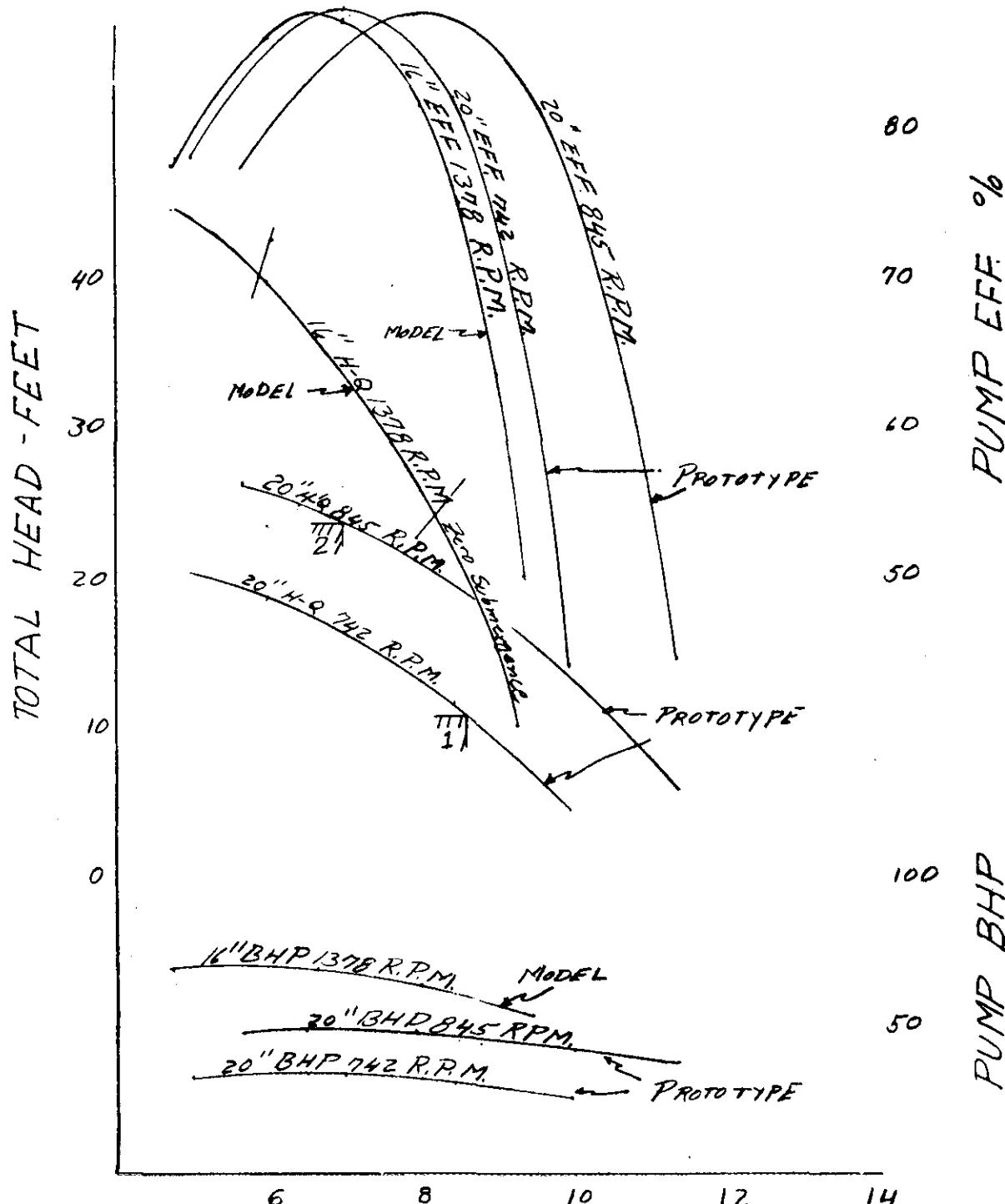
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C-26

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PROJECT CHICOPEE FALLS
SUBJECT LOCAL PROTECTION PROJECT
PUMP SELECTION - OAK ST.

PROJECT NO. 6205-2
SHEET NO. OF
DATE 3/26/63
COMPUTED BY B.P.
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CAPACITY - TGPM

C-27
REF PLATE #21C
20" MIXED

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 BOSTON, MASS.

PROJECT Chicopee Falls

SUBJECT Local Protection Project

Pump Selection - Oak St.

16" Axial Flow - Pump Selection Plate 19

#3 Condition Point #1 H = 10.8 Q = 8600

$$D_p = 20 \left(\frac{8600}{14625} \right)^{\frac{1}{2}} = 15.3" \text{ (use 16")}$$

$$Q_m = 8600 \left(\frac{20.0}{16.0} \right)^2 = 13450$$

$$H = 12.5 \quad Q_x = 13450 \left(\frac{12.5}{10.8} \right)^2 = 14470$$

$$H = 10.0 \quad Q_x = 13450 \left(\frac{10.0}{10.8} \right)^2 = 12950$$

$$N_c = 1037 \left(\frac{13450}{14000} \right) = 995$$

$$Q_p = Q_x \left(\frac{995}{1037} \right) \left(\frac{16.0}{20.0} \right)^2 = .615 Q_x$$

$$H_p = H_x \left(\frac{995}{1037} \right)^2 = .922 H_x$$

$$P_p = P_x \left(\frac{995}{1037} \right)^3 \left(\frac{16.0}{20.0} \right)^2 = .566 P_x$$

H _x	Q _x	P _x
32.5	9500	98.5
23.75	12000	83.0
11.75	14000	61.0
4.00	14900	43.0

H _p	Q _p	P _p	Eff.
30.0	5850	55.7	79.5
21.9	7380	46.1	88.6 Max.
10.8	8610	34.5	64.5
3.7	9170	24.3	35.3

$$N_p = \frac{20}{16} \times 995 = 1245$$

$$N_s = 9930 \quad H = 21.9 \quad 5' lift$$

C-28

PROJECT NO. 6205

SHEET NO. 1 OF 1

DATE 3/26/63

COMPUTED BY KOP

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PROJECT CHICOOPEE FALLS

SUBJECT LOCAL PROTECTION PROJECT
PUMP SELECTION - OAK ST.

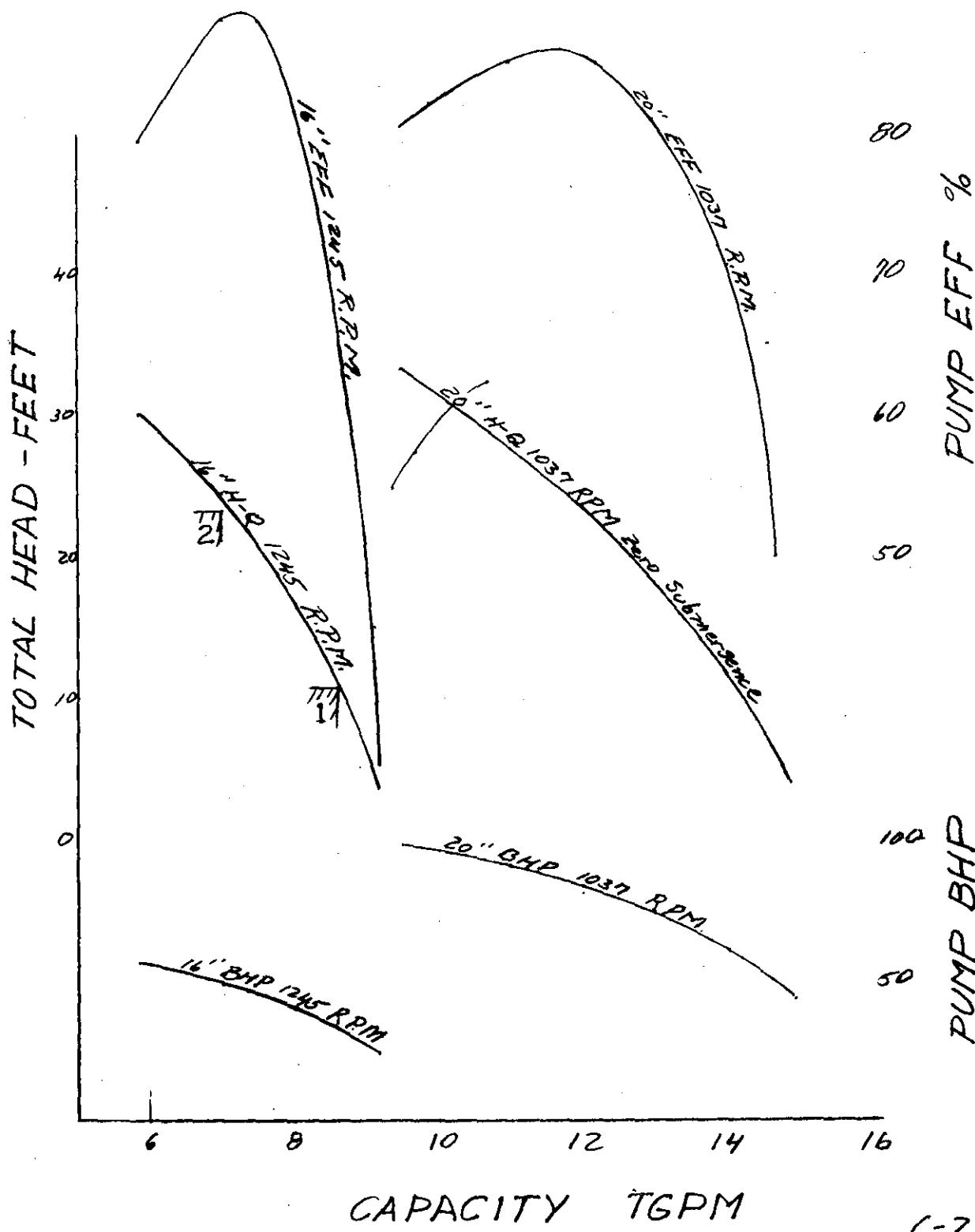
PROJECT NO. 6205-2

sheet no. of

DATE 3/26/63

COMPUTED BY RCP

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C-29

REF PLATE #19
16" Axial

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PROJECT Chicopee Falls

SUBJECT Local Protection Project

Pump Selection - Oak St.

18" Axial Flow - Pump Selection Plate 18 & 19

Condition Point # 2 Try 18"

$$Q_m = 7000 \left(\frac{20.0}{18.0} \right)^{\frac{1}{2}} = 7380$$

$$H_x = 25.0 \quad Q_x = 7380 \left(\frac{25.0}{23.5} \right)^{\frac{1}{2}} = 7620$$

$$H_x = 35.0 \quad Q_x = 7380 \left(\frac{35.0}{23.5} \right)^{\frac{1}{2}} = 9000$$

$$H_x = 32.5 \quad Q_x = 7380 \left(\frac{32.5}{23.5} \right)^{\frac{1}{2}} = 8670$$

Note: The line of constant specific speed lies beyond the limits of the H-Q curve. A pump can not be selected on this basis without extrapolating from the H-Q curves.
 No further selection will be attempted.

20" Axial Flow - Selection not attempted

No Curves Drawn

PROJECT NO. 6205
 SHEET NO. 1 OF 1
 DATE 3/26/63
 COMPUTED BY DD Palmer
 CHECKED BY

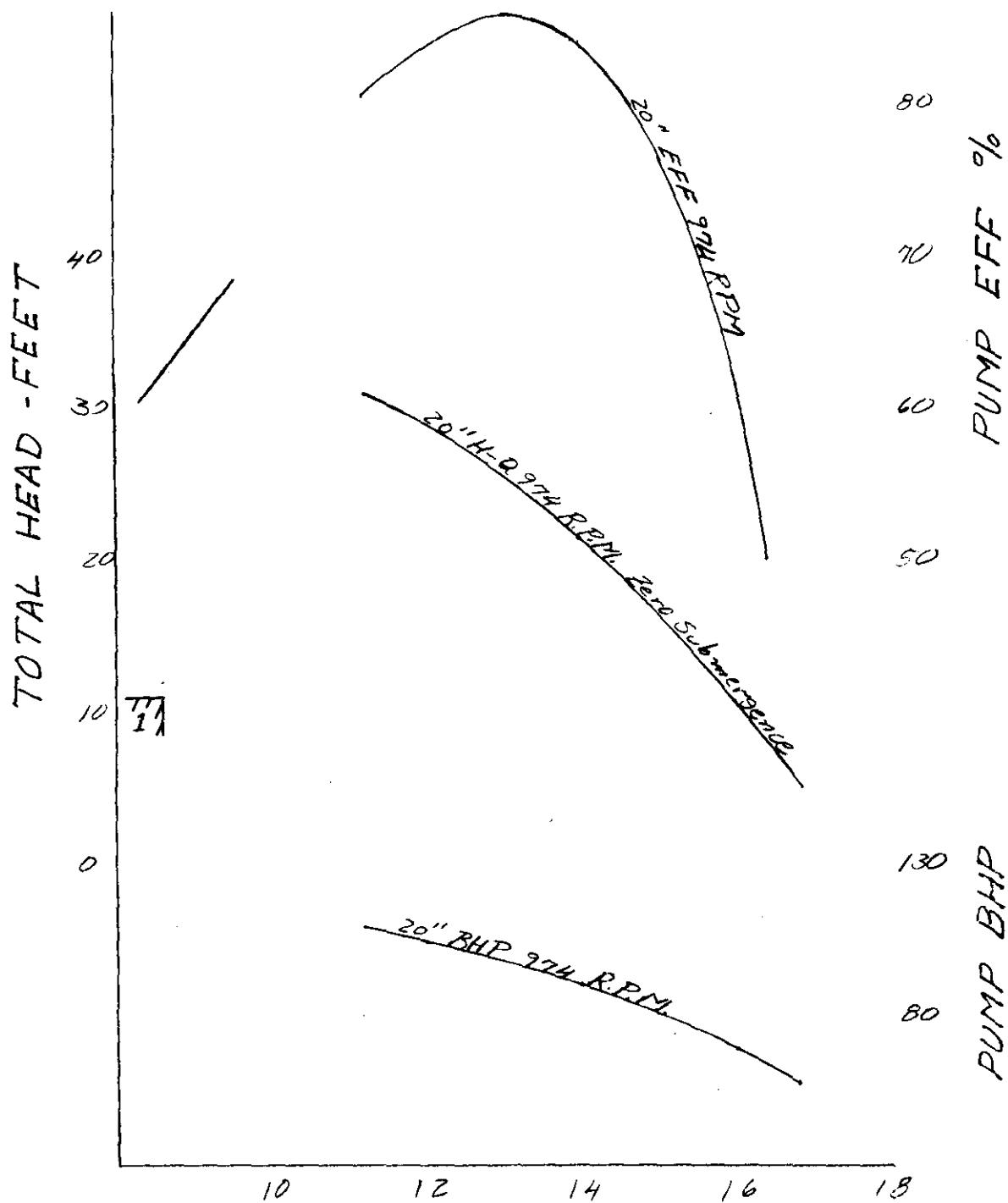
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BOSTON, MASS.

PROJECT CHICOPEE FALLS

SUBJECT Local Protection Project

PUMP SELECTION - OAK ST.

PROJECT NO. 6205
SHEET NO. OF
DATE 3/4/63
COMPUTED BY DGP
CHECKED BY _____



18" Axial

CAPACITY TGPM

C-31

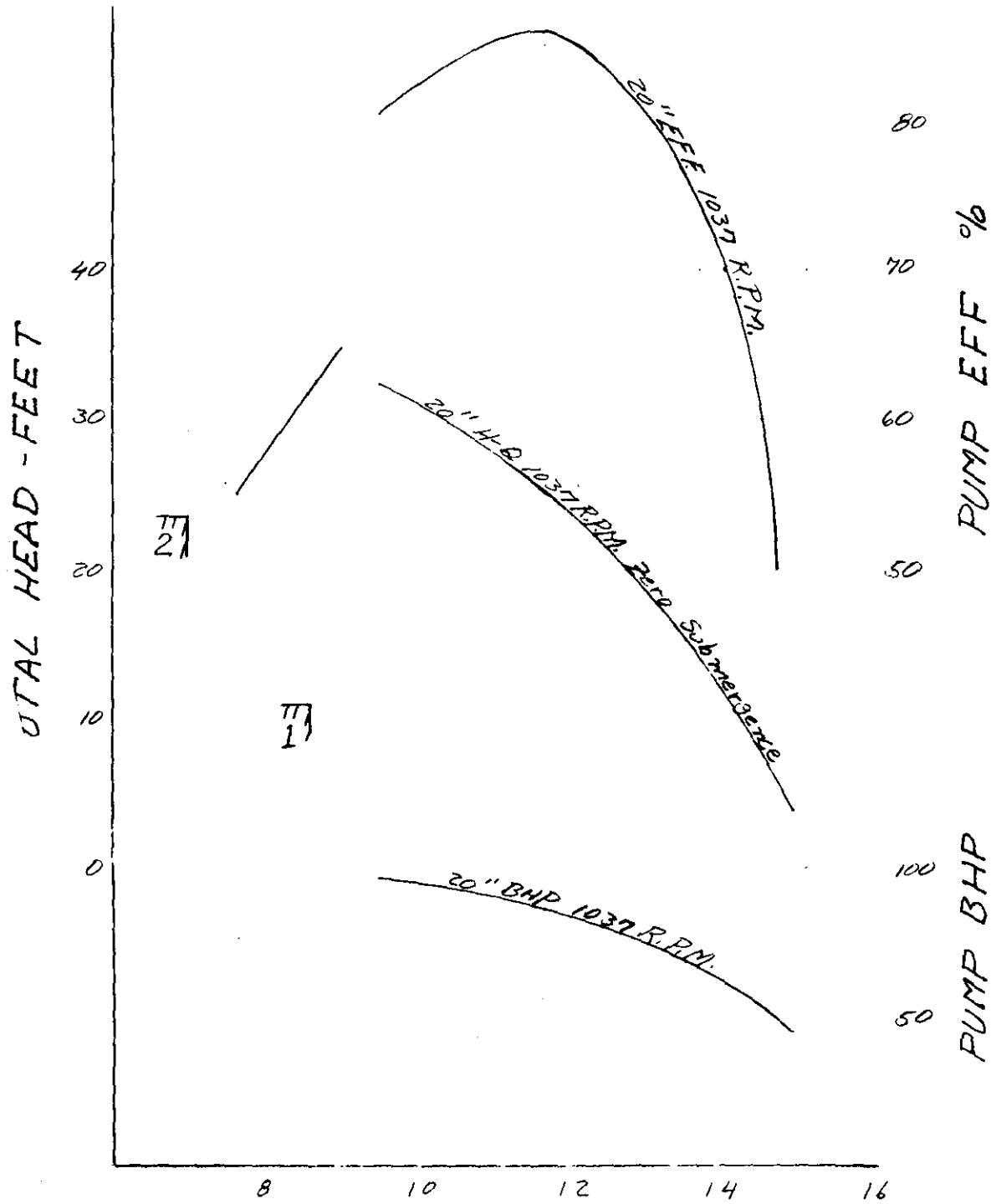
REF. PLATE #18

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PROJECT CHICORTEE FALLS

SUBJECT Local PROTECTION PROJECT
PUMP SELECTION - OAK ST

PROJECT NO. 6225-2
SHEET NO. 3/26/63 OF _____
DATE 3/26/63
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CAPACITY TGPM

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18" Axial

REF RATE #19

GREEN ENGINEERING AFFILIATES

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BOSTON, MASS.

Project Chilocope Falls

卷之三

Jump Selection Dark Side

PROJECT NO. 6205
SHEET NO. 3/26/63 OF 1
DATE 3/26/63
COMPUTED BY R.P.
CHECKED BY

GREEN ENGINEERING AFFILIATES
ENGINEERS
BOSTON, MASS.

PROJECT CHICOOEE FALLS

SUBJECT Local Protection Project
Pump Selection - Main St.
EFFECT OF VARYING SPEED

PROJECT NO. 6205-2
 SHEET NO. 30 OF _____
 DATE 4-2-63
 COMPUTED BY _____
 CHECKED BY _____

$$N_p = 1269 \text{ RPM}$$

$H_p (1269)$	$Q_p (1269)$	$H (1200)$	$Q_p (1200)$	$H (1000)$	$Q (1000)$
9.6	9950	8.6	9350	5.9	7850
14.4	9700	12.8	9100	8.9	7650
19.2	9300	17.1	8750	11.9	7350
24.0	8800	21.4	8300	14.8	6900
33.6	7100	30.0	6700	20.8	5600

$$\Phi_{1200} = \frac{1200}{1269} Q_p = .94 Q_p$$

$$H_{800} \quad \Phi_{800}$$

$$3.8 \quad 6300$$

$$5.8 \quad 6100$$

$$\Phi_{1000} = \frac{1000}{1269} Q_p = .79 Q_p$$

$$7.7 \quad 5850$$

$$H_{1000} = \left(\frac{1000}{1269}\right)^2 H_p = .62 H_p$$

$$9.6 \quad 5500$$

$$13.1 \quad 4500$$

$$\Phi_{800} = \frac{800}{1269} Q_p = .63$$

$$H_{800} = \left(\frac{800}{1269}\right)^2 H_p = .4$$

GREEN ENGINEERING AFFILIATES
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BOSTON, MASS.

PROJECT NO. 6205-2

SHEET NO. 06

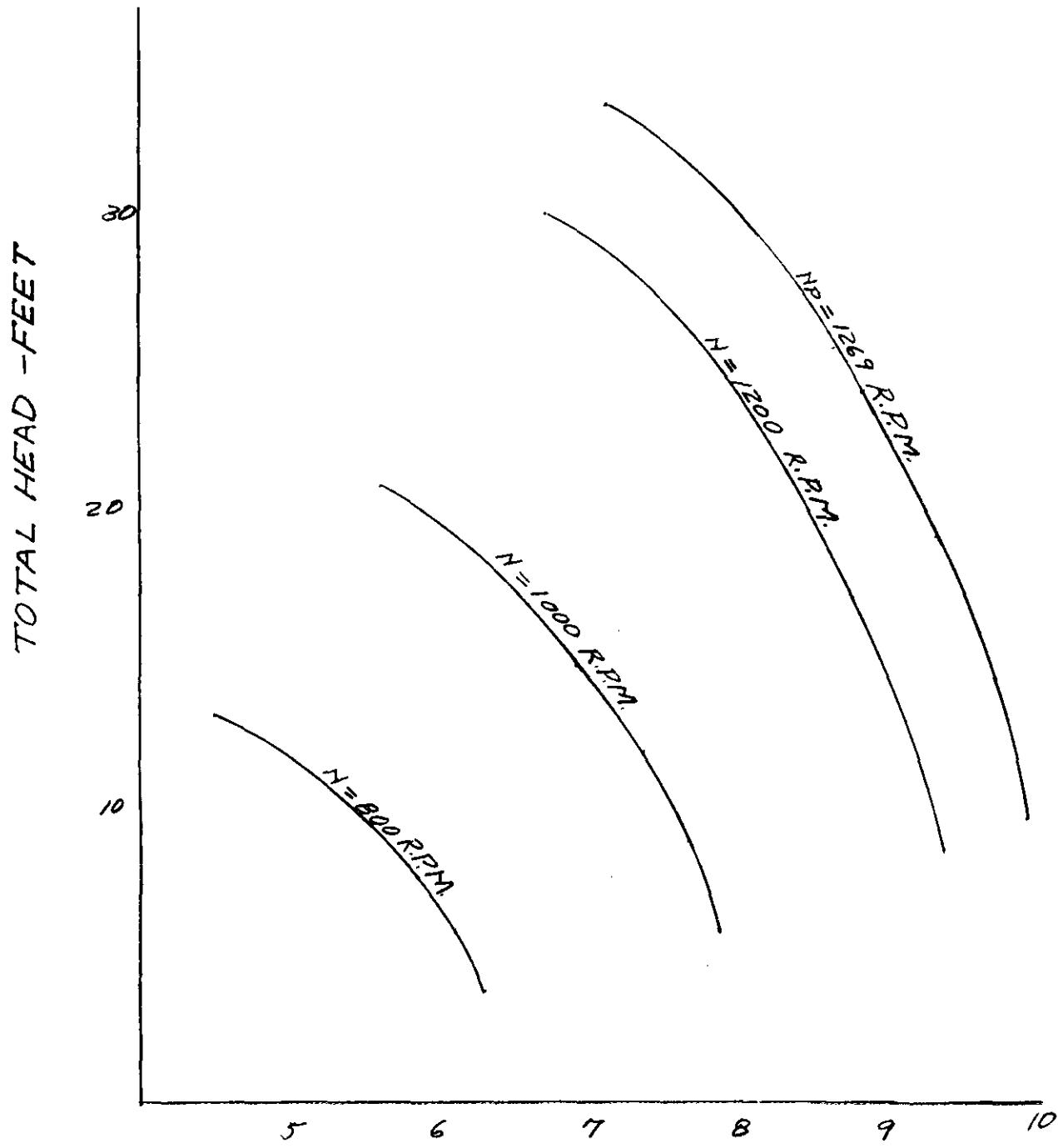
DATE 4/2/63

COMPUTED BY _____

CHECKED BY _____

PROJECT CHICOPEE FALLS
SUBJECT LOCAL PROTECTION PROJECT
PUMP SELECTION - MAIN ST.

EFFECT OF VARYING SPEED



CAPACITY - TGPM

GREEN ENGINEERING AFFILIATES
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BOSTON, MASS.

PROJECT Chicopee Falls

SUBJECT Local Protection Protection
Pump Selection - Oak St.

PROJECT NO. 6205-2
SHEET NO. 32 OF _____
DATE 4-2-63
COMPUTED BY _____
CHECKED BY _____

Effect of varying speed

$$N_p = 1245 \text{ RPM}$$

H_p	Q_p	H_{1100}	Q_{1100}	H_{800}	Q_{800}
30	5850	23.5	5150	12.3	3750
21.9	7380	17.0	6500	9.0	4700
10.8	8610	8.5	7600	4.4	5500
3.7	9170	2.9	8100	1.5	5850

$$Q_{1100} = Q_p \frac{1100}{1245} = .88 Q_p$$

$$H_{1100} = H_p \left(\frac{1100}{1245} \right)^2 = .78 H_p$$

$$Q_{800} = Q_p \frac{800}{1245} = .64 Q_p$$

$$H_{800} = H_p \left(\frac{800}{1245} \right)^2 = .41 H_p$$

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PROJECT CHICOPEE FALLS
SUBJECT LOCAL PROTECTION PROJECT
PUMP SELECTION - OAK ST.

PROJECT NO. 6205-2
SHEET NO. OF
DATE 4/2/63
COMPUTED BY
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EFFECT OF VARYING SPEED

